DNA 4374F

SUMMARY OF OPERATIONS

DNA Master File of Ground-Shock, Air-Blast, and Structure-Response Data

Agbabian Associates
250 North Nash Street
El Segundo, California 90245

22 September 1977

Final Report for Period 1 October 1975—30 September 1977

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Air Blast	Ground Shock	MINERAL LOAD	PRAIRIE FLAT
Archiving	High-Explosive Tests	MINERAL ROCK	Processing
DATA/70S	HOB Data	MINE THROW	Retrieval
DIAL PACK	MIDDLE GUST	MINE UNDER	Structural Response
DISTANT PLAIN	MINE ORE	MIXED COMPANY	

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The document presents examples of data processing that were requested by users of the Defense Nuclear Agency Archive of high-explosive test data. Guidelines are also presented that enable data analysts to estimate the computer hours and labor hours that will be required to perform certain typical data processing operations.

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SUMMARY

For nearly 35 years, the U.S. Government has been acquiring air blast, ground response, and structure response data from a variety of experiments beginning with the atomic bomb tests in the continental United States, through the thermonuclear events in the South Pacific and, for the last decade or so, from high-explosive events conducted in the United States and Canada.

The presently reported work describes the status of an effort to consolidate some of these data in a repository known as the DNA Master File of Ground-Shock, Air-Blast, and Structure-Response Data, but often called the DNA Archive for brevity. A description of past activities is presented in this document, together with the results of a limited-use program to introduce the workings of the system to the technical community. Computer usage guidelines for the benefit of investigators wishing to estimate the cost of processing data utilizing the capabilities of the data retrieval and processing system that comprises part of the DNA Archive is also presented.

Much has been written about the DNA Archive, and this document makes use of such published information; it is not intended to be a self-sufficient reference source. Moreover, this document covers a period when most of the time was dedicated to acquiring and filing data and exposing the DNA Archive to potential users. Only a relatively minor effort has been expended on using the data. Accordingly, it is likely that updated information will be made available from time to time. The user should satisfy himself that more recent information has not been published on the subject.

PREFACE

The development of the DNA Archive, its subsequent exposure to the technical community, and the results and usage guidelines were all supported by the Defense Nuclear Agency. Major R. Waters was the Contracting Officer's representative during the early part of the work. He was succeeded by Lt. Col. D. Burgess who, in turn, was recently succeeded by Maj. D. Spangler. The initial effort began in late 1972 under Contract No. DNA001-73-C-0058. The work continued under Contract No. DNA001-75-C-0154 and was completed under the present contract, DNA001-76-C-0100.

The nature of the most recent phase of the program required the attendance and participation of many individuals at the DNA Data Archive Seminar. Their participation is gratefully acknowledged. Special thanks are extended to B.A. Bolt of the University of California, J.L. Bratton of the Air Force Weapons Laboratory, J.D. Collins of the J.H. Wiggins Company, H.F. Cooper, Jr. of R&D Associates, P.F. Hadala and R.E. Walker of the Waterways Experiment Station, D.E. Hudson of the California Institute of Technology, and N. Lipner of the TRW Systems Group for their contributions to the program. Finally, the interest, support, and involvement of M.C. Atkins, E. Sevin, D.N. Burgess, and D.R. Spangler of the Defense Nuclear Agency are appreciated.

The program manager at Agbabian Associates was J.A. Malthan. He was assisted by M.S. Agbabian, R.D. Ewing, E.M. Raney, and J.W. Workman. K.T. Dill, S.S. McClellan, S.D. Nelson, and D.G. Yates provided critical support to the program.

CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS

ILLUSTRATIONS

TABLES

SECTION 1

INTRODUCTION

The DNA Data Archive project was formally initiated in the fall of 1972 as the result of a long-standing desire to consolidate ground-shock and air-blast time history data from nuclear and nuclear-simulation field tests into an archive for safekeeping and from which data could be retrieved on demand. A major milestone in the program was reached in the fall of 1975, when the archiving of data from the high-explosive (HE) events listed in Table 1-1 was completed.

A description of these test events and the nature of the data in the DNA Archive is presented in Reference 1.

The DNA Data Archive comprises more than a data retrieval system. It also includes computer software providing data management functions, a data processing capability to perform a variety of time series processes on the data, and a data output system for printed, taped, punched, and plotted formats. These capabilities have been reported extensively in References 1, 2, and 3.

In 1975, the direction of the program turned from a primarily archiving activity into an information dissemination function. The purpose of the latter was to educate potential analysts and others interested in these data to the content and use of the Archive. This was achieved by the presentation of a seminar in October 1976, in which the content of the Archive was described including the identification system applied to the data (Ref. 1), the directory system that allows users to locate particular files (Ref. 4), examples of data processing procedures that were reported in a separate volume (Ref. 5), a summary of the events whose data are represented in the Archive (Ref. 6), and a series of lectures (listed in Appendix A) describing contemporary problems associated with nuclear weapon effects.

TABLE 1-1. TIME HISTORIES IN THE DNA DATA ARCHIVE

Event	Data Type			
	Ground Motion	Stress or Strain	Air Blast	Structure Response
DISTANT PLAIN			X	
PRAIRIE FLAT		X	X	
DIAL PACK	X	X		
MINE UNDER	X	X	X	
MINE ORE	X	X	X	
MINERAL LODE	X	X		
MINERAL ROCK	X		X	
MIXED COMPANY	X	X	X	X
MIDDLE GUST	X	X	X	X
MINE THROW	X			
100-lb HOB			X	
8-lb HOB			X	

Investigators interested in studying the background and development of the DNA Archive are encouraged to consult the referenced documents.

1.1 ORGANIZATION OF REPORT

This document is organized in two basic parts. The first part presents examples of data processing that were requested by users after presentation of the seminar. The second part includes guidelines that investigators may use in estimating the computer and labor hours that will be required to perform certain typical data processing operations.

SECTION 2

EXAMPLES OF DATA PROCESSING REQUESTS

At the completion of the seminar, attendees were invited to use the DNA Archive at no direct cost to themselves. The purpose of the offer was to allow users to familiarize themselves with the Archive and to provide DNA with information on the projected costs and future activities of the program.

Four organizations responded to the offer: R&D Associates; Physics International Company; Systems, Science and Software; and the Boeing Aerospace Company. This document presents the results of all requests other than that of Systems, Science and Software, whose request was not fulfilled by direction of DNA.

In order to provide maximum usefulness to future users, the processing requests are presented as the original request, the decisions related to and the results obtained from the actual processing, comments on the output by the requesters, and the concluding remarks referring to the processing and the interchange of information.

2.1 REQUEST FROM R&D ASSOCIATES

When constructing shock spectra without resorting to direct computation, manual techniques are often used to obtain an approximation of shock spectra. Thus, if an acceleration time history and its integrations indicate peak acceleration, velocity, and displacement denoted by A, V, and D, respectively, an approximation of the shock spectrum can be obtained by constructing an envelope from the three straight line segments on a tripartite graph where the magnitude of the lines are 2A, 1.5V, and D, respectively. The result is typified in Figure 2-1.

The purpose of the present task was to determine how accurate this approximation is for ground-shock data obtained from tests conducted in the clay-like materials of the Suffield test site in Canada.

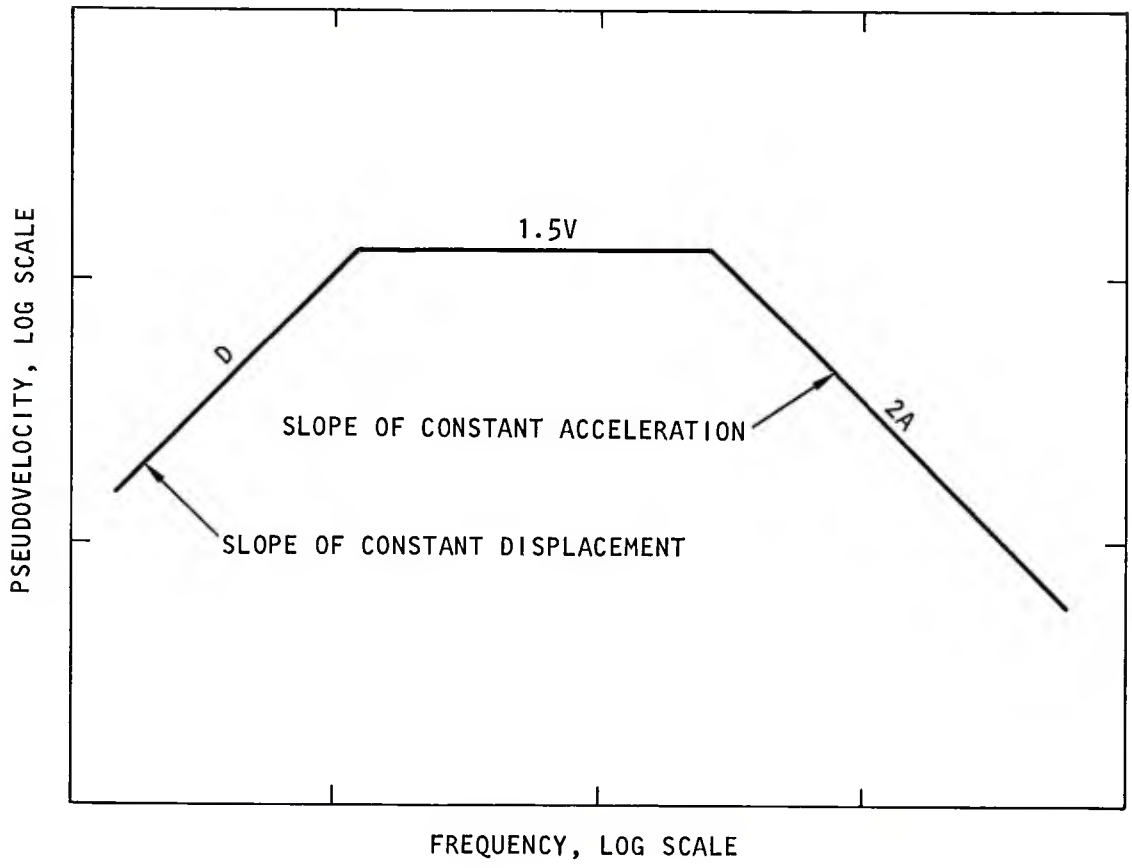


FIGURE 2-1. MANUAL CONSTRUCTION OF SHOCK SPECTRUM

2.1.1 DATA CONSIDERED

The data in the study included the following files:

PRAIRIE FLAT	DIAL PACK
2681	3380
2649	3384
2898	3362
2666	3465
	3453
	3457

The reader should consult Reference 4 for the identification of these data.

2.1.2 PROCESSING INSTRUCTIONS

The instructions for processing these data were quite specific and occurred as negotiated conversations via telephone or in person. Essentially no written instructions were provided. The instructions are shown in Table 2-1. The data were to be plotted as standard shock spectra, i.e., as pseudovelocity plotted against frequency.

2.1.3 PROCESSING ASSUMPTIONS

The reader can review the input parameters associated with the computation of shock spectra in Reference 2 (for the SHOXVE option), and note that the proper execution of the run requires consideration of more constraints than are provided by Table 2-1. Since the maximum spectra were to be computed only for the forced era of the time histories, there was no need to taper the rear of the records and the front was not tapered in order to preserve the actual pulse shape. Knowing that the spectra were to be used to corroborate the factors discussed in Section 2.1, the spectra plots were exactly sized to fit standard tripartite shock spectra graph paper so that the final plotted data on vellum could be overlaid on standard graph paper.

TABLE 2-1. PROCESSING INSTRUCTIONS

File	Time Duration of Measurement, msec	Spectra Frequency Spacing	Damping Ratio
2681	80	25 Logarithmically Spaced Frequencies between 6 and 800 Hz	None
2649	80		
2898	150		
2666	200		
3380	100		
3384	100		
3362	100		
3465	200		
3453	250		
3457	300		

All data were decimated from their various original sampling rates to 3000 sps. This was performed to reduce computation time in the shock spectra processors, and it was performed via the DECILP (see Ref. 2) processing option in which the default values for the low-pass filter were selected (1500 Hz cutoff, 6-pole Butterworth tangent type) with no preloading* provided, since the records indicated an acceleration that began with essentially zero initial conditions. See Section 2.1.6 for the implications of data decimation.

2.1.4 OUTPUT

The plotted output for the processing request is presented in Figures 2-2 through 2-11. Each figure shows the original acceleration time history and its integration. Displacements were not computed since the very low-frequency characteristics of the shock spectra were not of immediate interest. Each figure also shows the computed shock spectrum. For convenience, the approximated envelope developed from the factors shown in Figure 2-1 are overlaid as dashed lines on the figures.

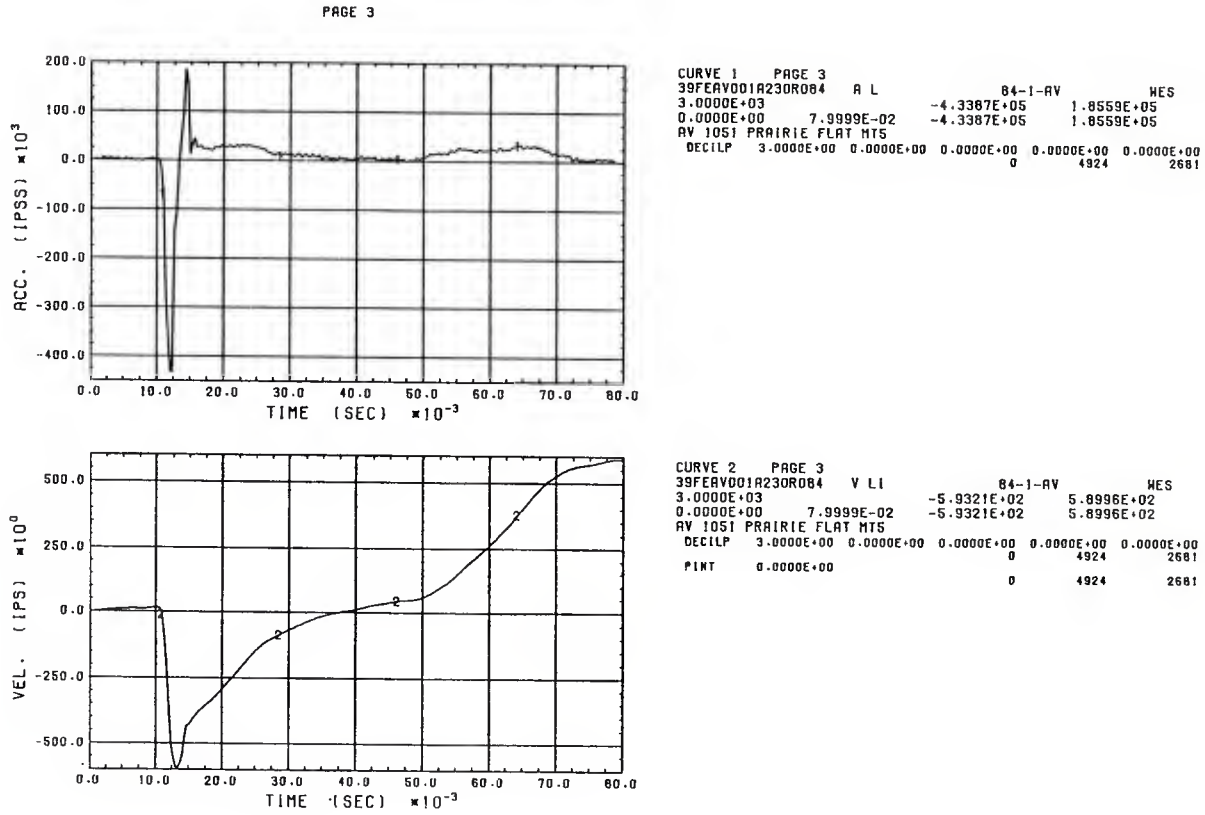
2.1.5 REQUESTOR'S COMMENTS

The data presented in Figures 2-2 through 2-11 were submitted to the requestor. Aside from technical questions concerning the algorithm used in the shock spectrum processor, no comments were received.

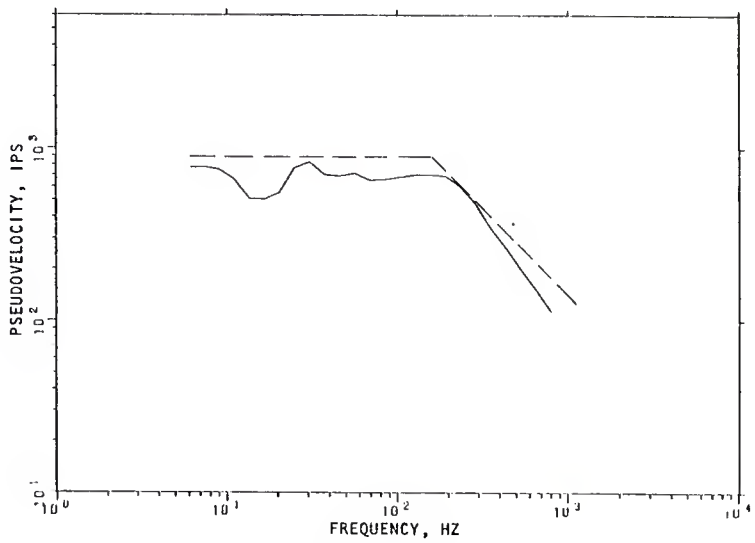
2.1.6 CONCLUSIONS

An examination of the plots in Figures 2-2 through 2-11 suggests that the acceleration records contained some offset and drift. This is especially evident in Figure 2-4 where the maximum value of the velocity time history occurs at late time, apparently as the result of a baseline error in the acceleration measurement. It is to be noted, however, that the shock spectrum for this record does not differentiate baseline errors from true data, since the constant velocity line on the spectrum estimated from

*Note: Preloading is implemented if the record to be filtered begins with nonzero initial conditions. It "warms up" the filter and sets the initial conditions to the measured values.

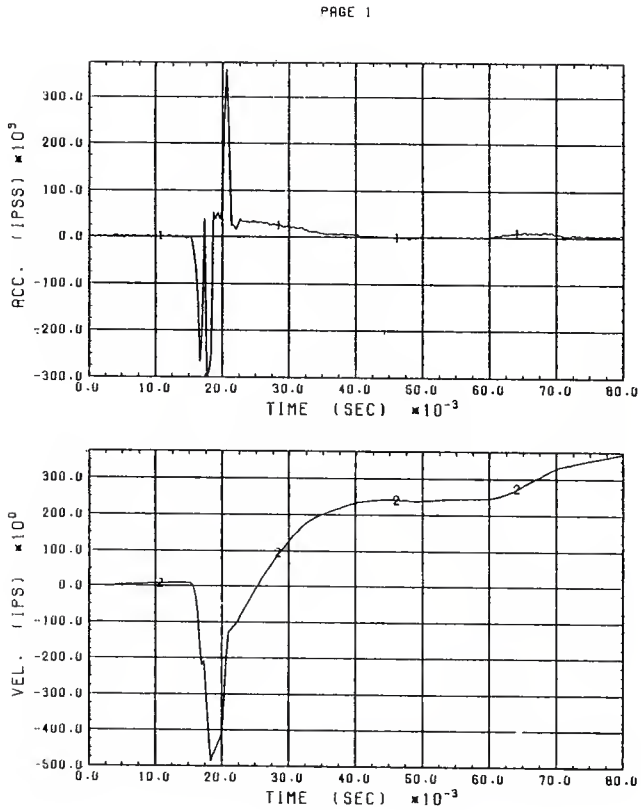


(a) Acceleration and velocity--time histories



(b) Shock spectrum

FIGURE 2-2. PLOTTED OUTPUT FOR FILE 2681



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-AV 1071 PRAIRIE FLAT MT4
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-AV 1071 PRAIRIE FLAT MT4
DECILP 3.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00
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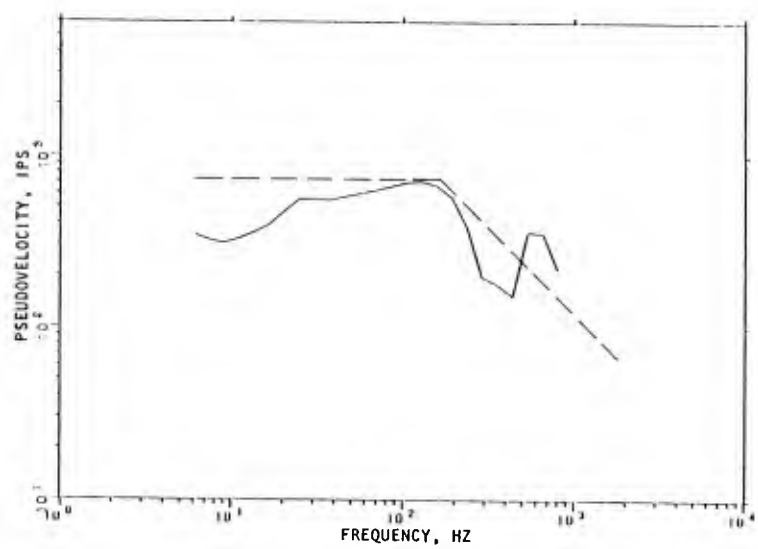
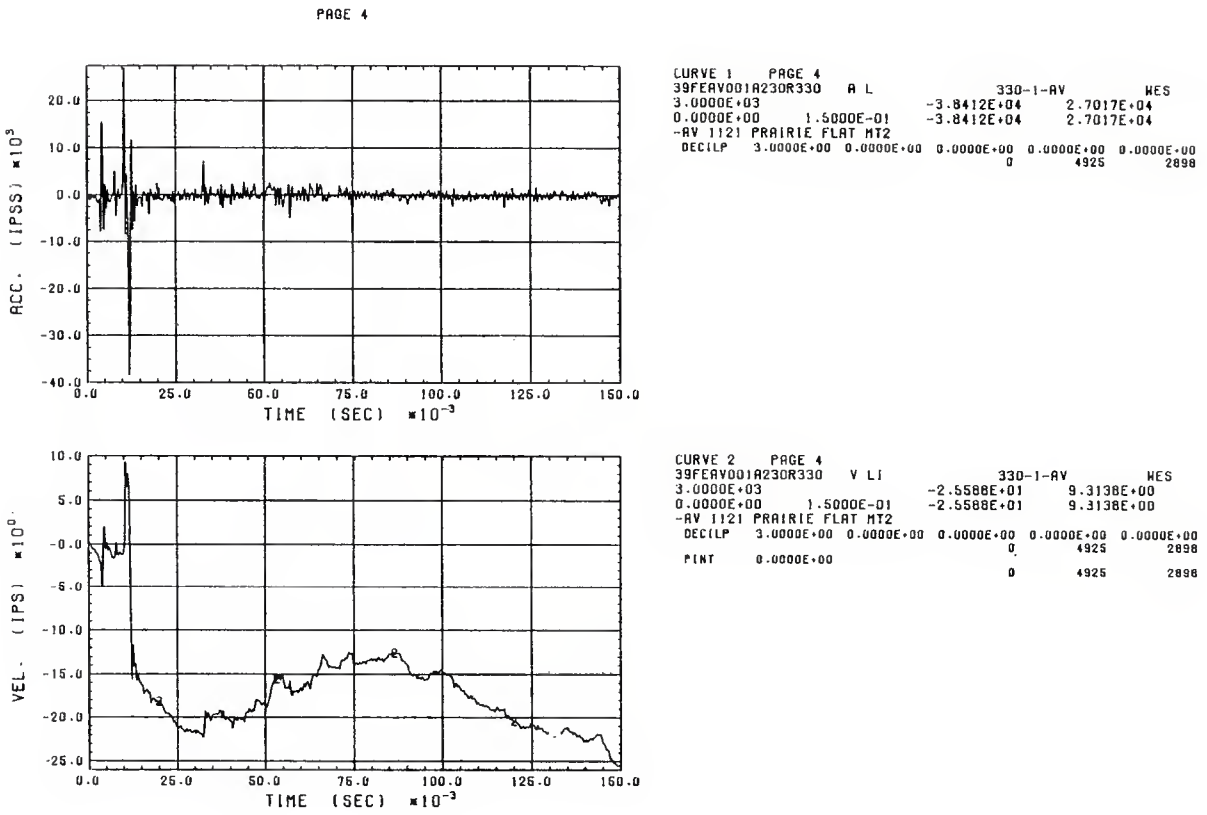
(a) Acceleration and velocity--time histories

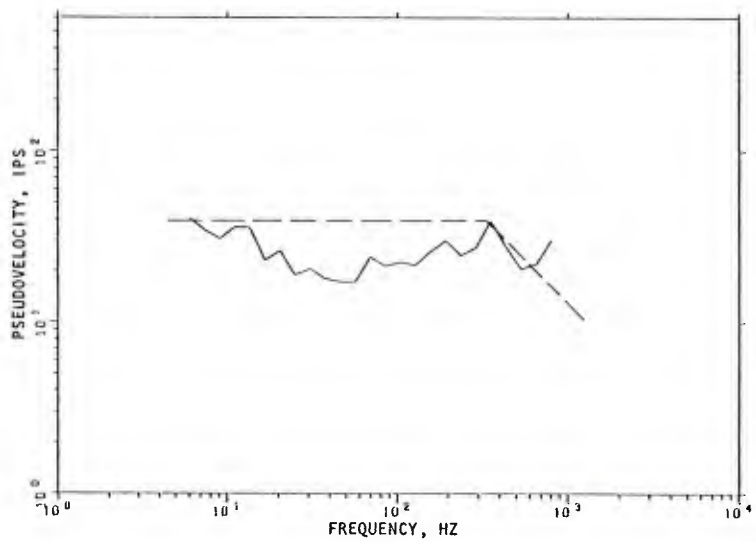


(b) Shock spectrum

FIGURE 2-3. PLOTTED OUTPUT FOR FILE 2649

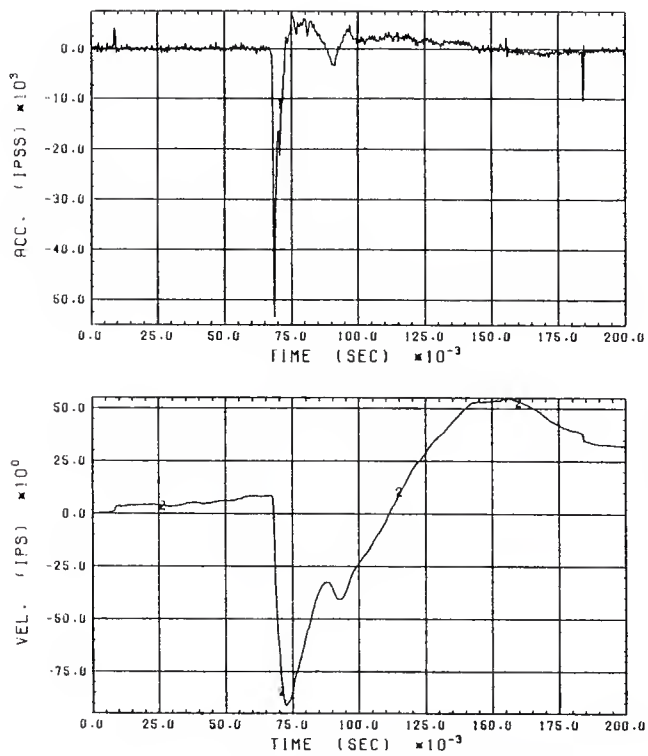


(a) Acceleration and velocity--time histories



(b) Shock spectrum

FIGURE 2-4. PLOTTED OUTPUT FOR FILE 2898



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CURVE 2 PAGE 2
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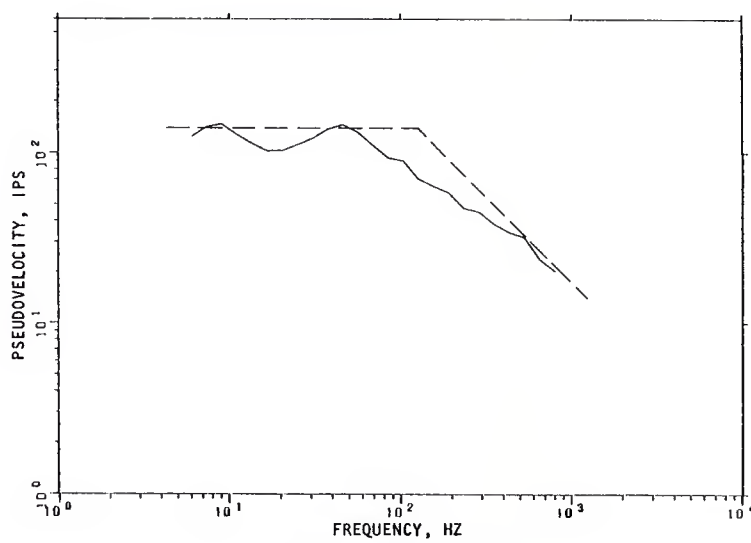
(a) Acceleration and velocity--time histories



(b) Shock spectrum

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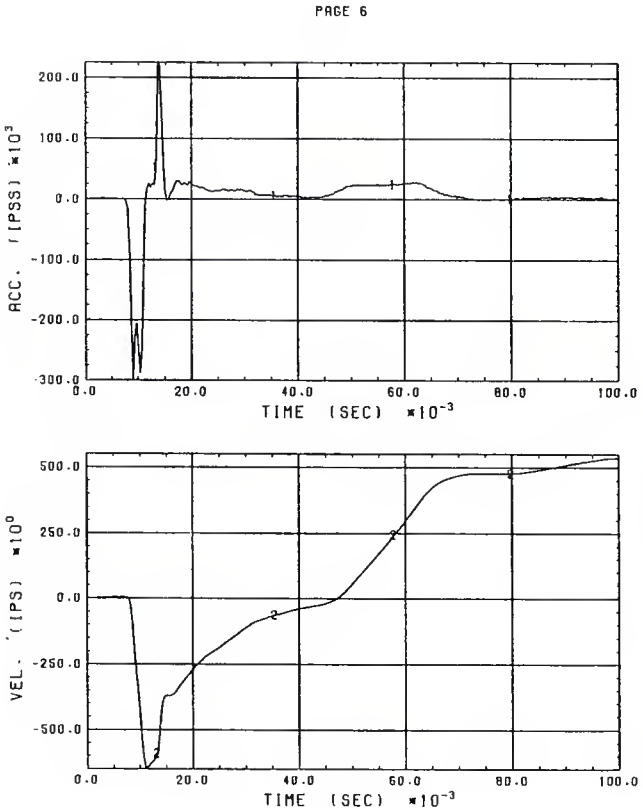

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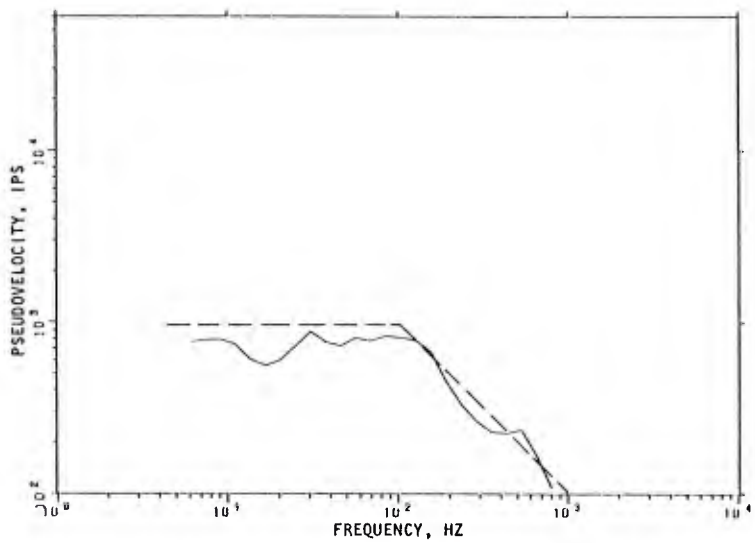
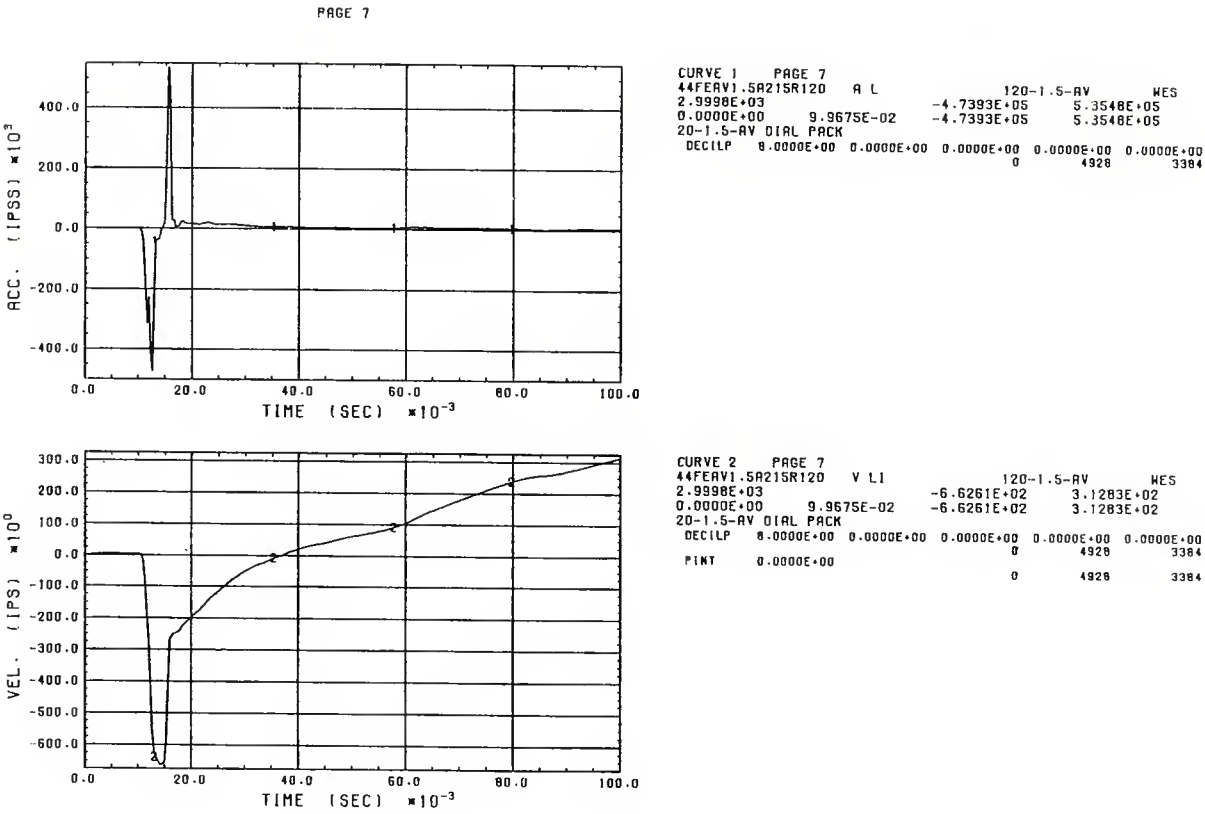
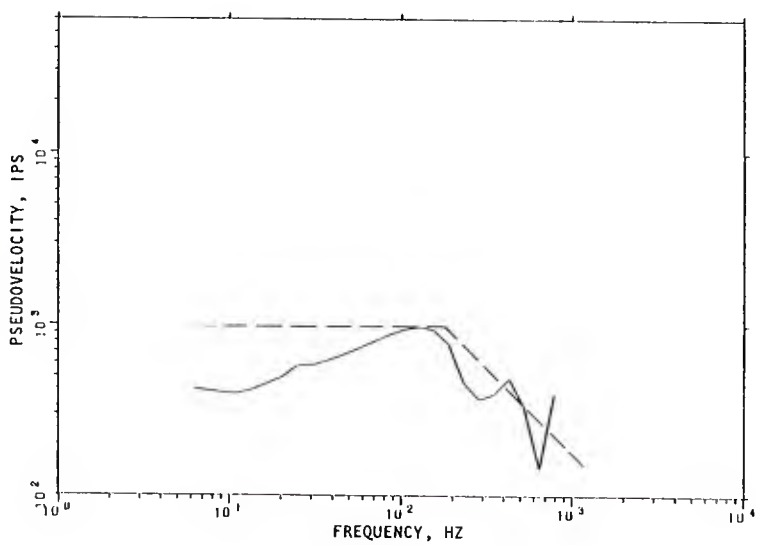


(b) Shock spectrum

FIGURE 2-6. PLOTTED OUTPUT FOR FILE 3380

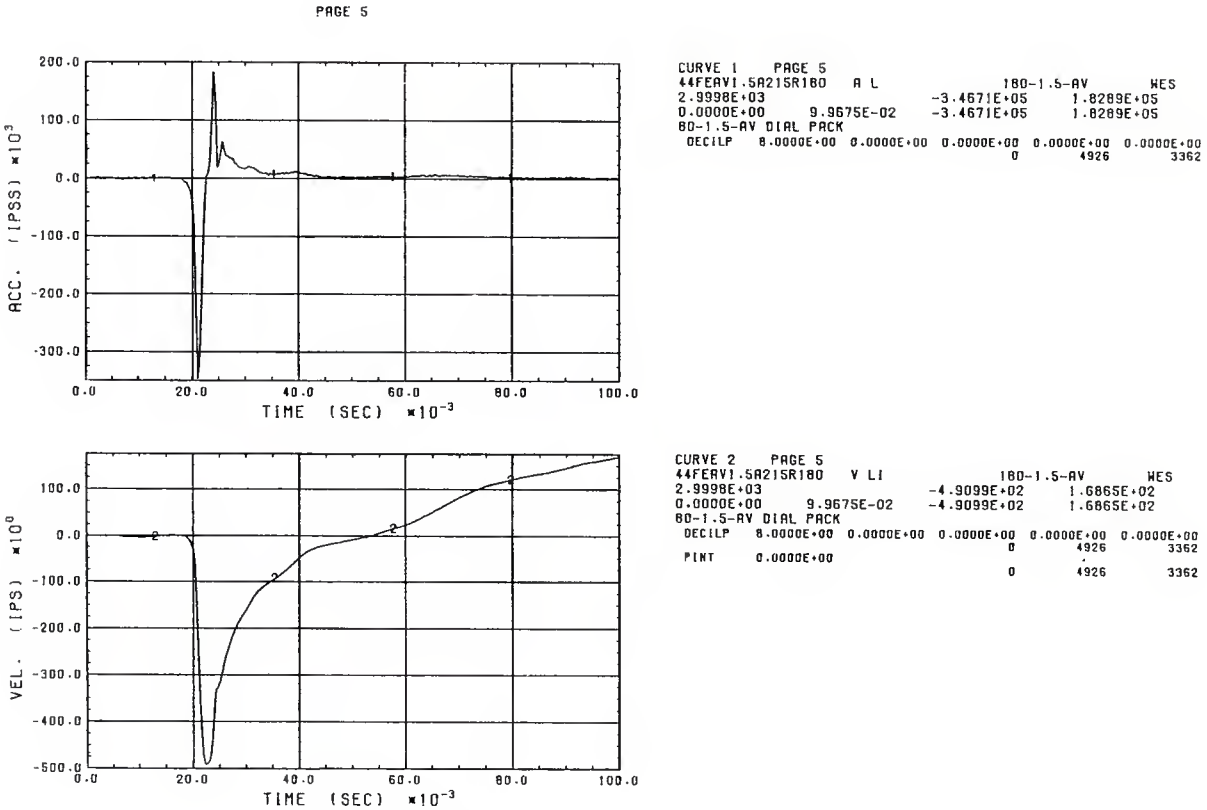


(a) Acceleration and velocity--time histories

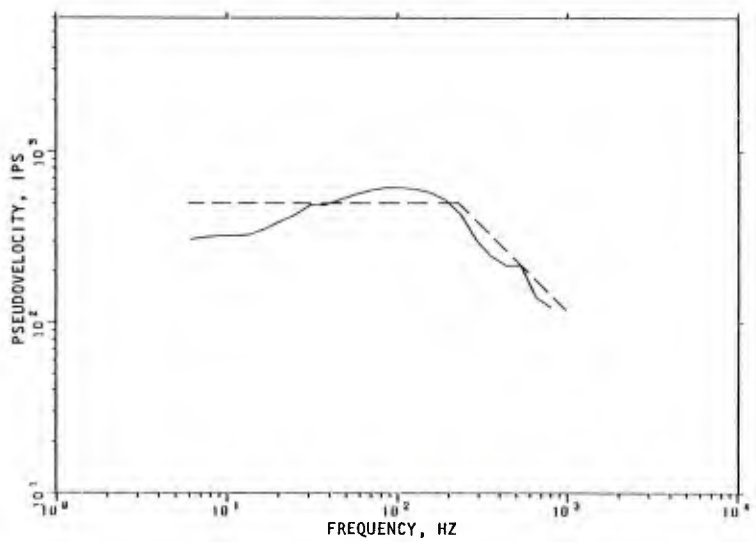


(b) Shock spectrum

FIGURE 2-7. PLOTTED OUTPUT FOR FILE 3384

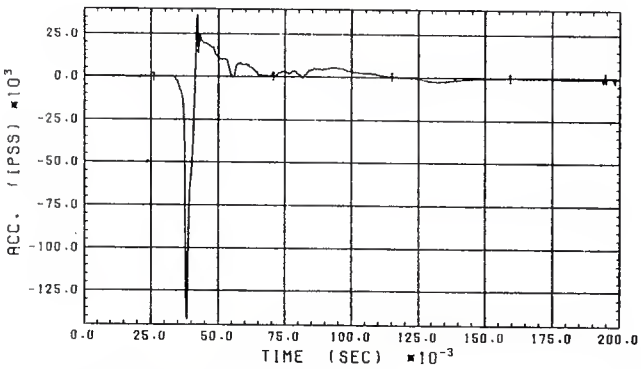


(a) Acceleration and velocity--time histories



(b) Shock spectrum

FIGURE 2-8. PLOTTED OUTPUT FOR FILE 3362



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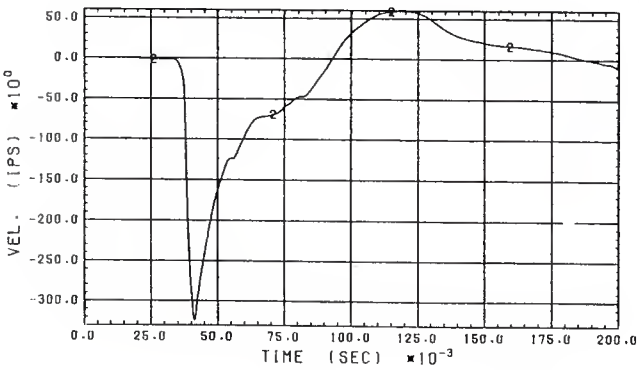

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70-1.5-AV DIAL PACK
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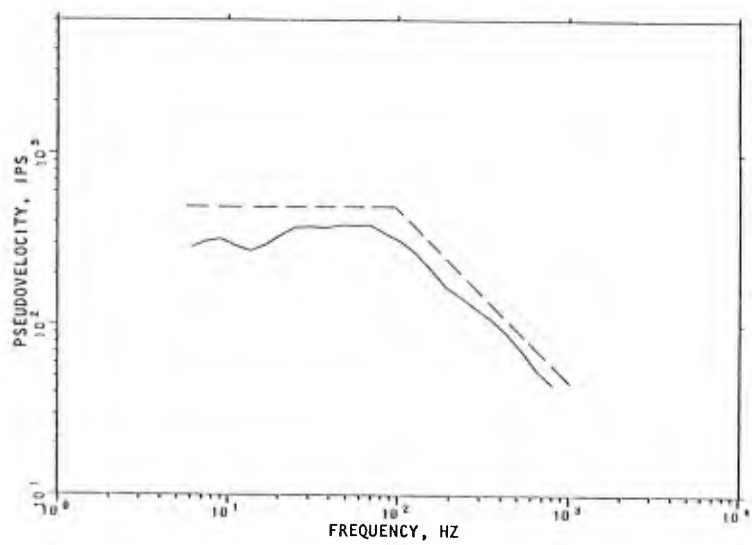
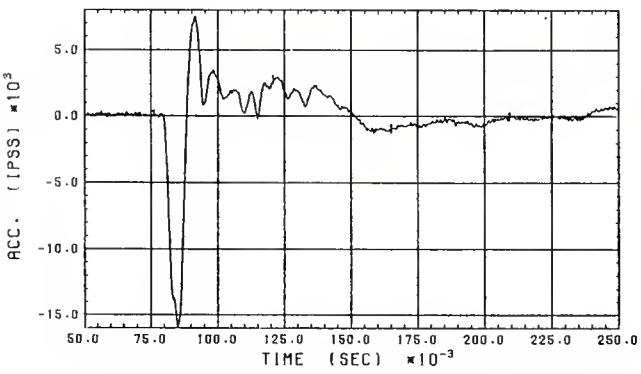
0 4931 3465

(a) Acceleration and velocity--time histories



(b) Shock spectrum

FIGURE 2-9. PLOTTED OUTPUT FOR FILE 3465

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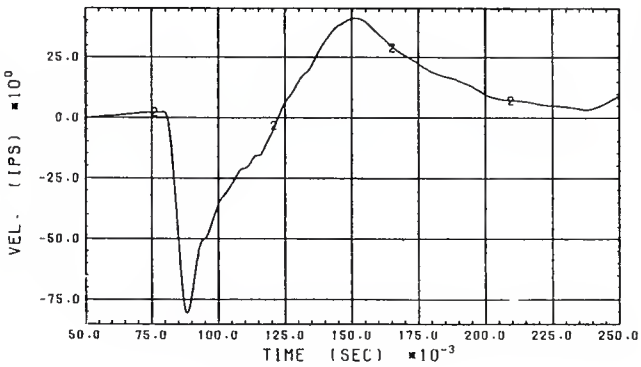


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25-1.5-AV DIAL PACK
 DECILP    0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
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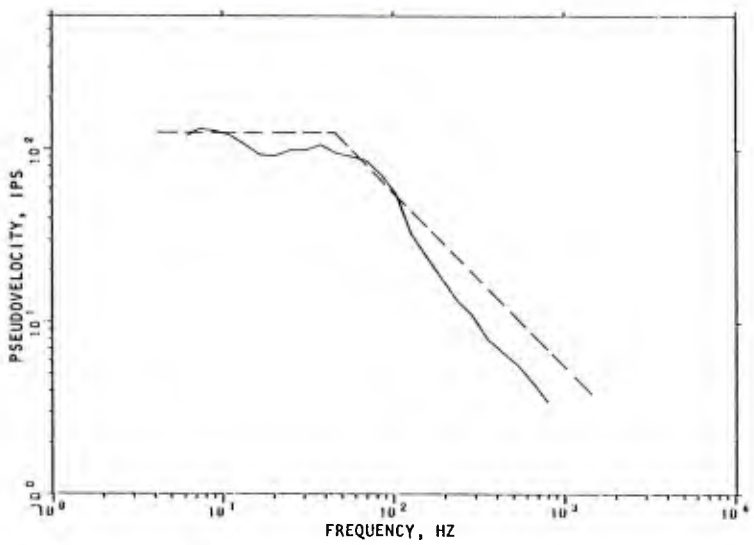
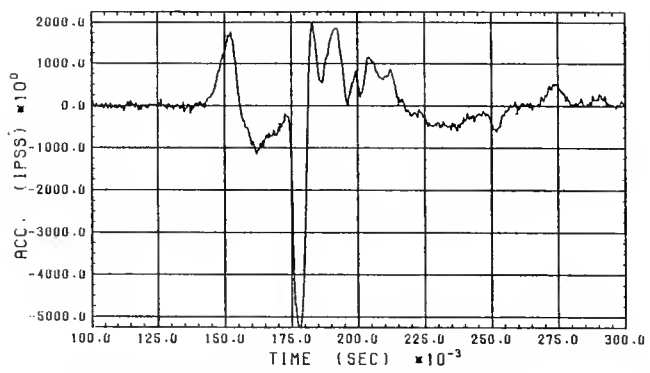
(a) Acceleration and velocity--time histories



(b) Shock spectrum

FIGURE 2-10. PLOTTED OUTPUT FOR FILE 3453

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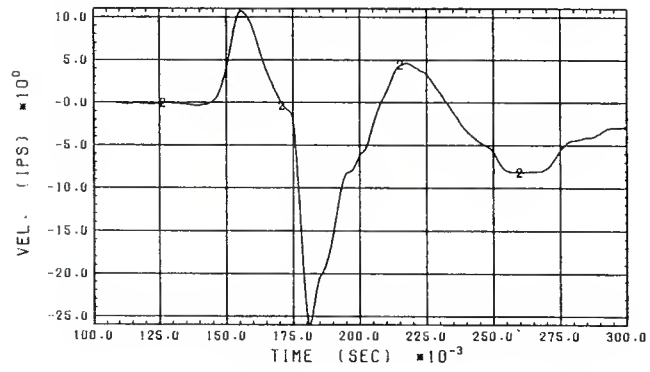
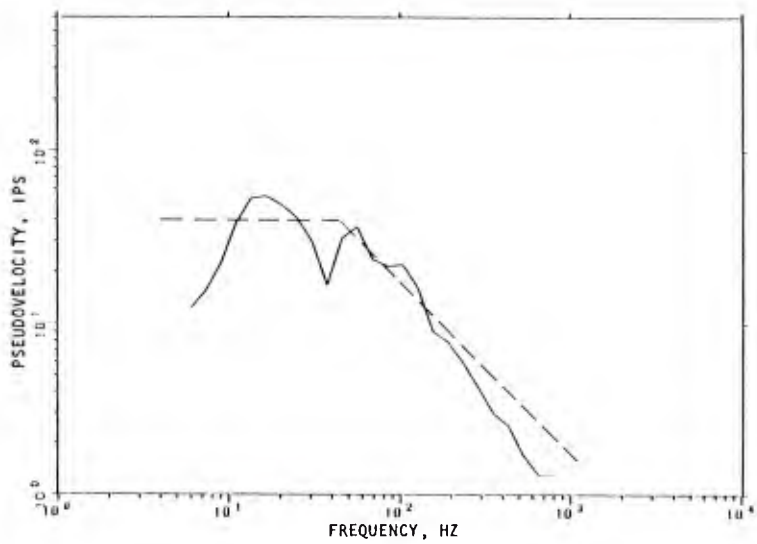
4 645-1.5-AV DIAL PACK
 DECILP    4.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
                                          0        4929        3457
```




```
CURVE 2    PAGE 8
44FEAV1.5A21SR64S    V LI               645-1.5-AV        WES
3.0001E+03                        -2.5985E+01      1.0719E+01
1.0033E-01      2.9999E-01        -2.5985E+01      1.0719E+01
4 645-1.5-AV DIAL PACK
 DECILP    4.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
                                          0        4929        3457
 PINT      0.0000E+00
                                          0        4929        3457
```

(a) Acceleration and velocity--time histories



(b) Shock spectrum

FIGURE 2-11. PLOTTED OUTPUT FOR FILE 3457

the largest amplitude of the velocity agrees very well with the computed spectrum. Thus, the purpose of the processing was achieved. However, it is to be noted that the computed spectra in Figure 2-4 and all other figures are not the true spectra, since baseline errors distort the spectra in the constant displacement and constant velocity regimes.

An additional point to be noted has to do with the accuracy of computed shock spectra as a function of frequency and sampling rate. If f_s and f_r are the sampling rate and frequency of interest in the computation of the shock spectra, the expected error in computing the spectra will be (Ref. 7):

$$e(\%) = 100 \left(1 - \frac{\sin \pi f_r/f_s}{\pi f_r/f_s}\right) \qquad (2\text{-}1)$$

Thus, when f_r = 800 Hz and f_s = 3000 sps, $e \simeq 10\%$, which is the expected error at the highest frequency of interest in the analysis.

2.2 REQUEST FROM PHYSICS INTERNATIONAL COMPANY

An area of high uncertainty in nuclear weapon effects technology is the crater-induced ground motion. Physics International suggested that data in the Archive might be used to develop scaling rules by using the fast Fourier transform (FFT). A selection of measurements was considered in an attempt to investigate the problem.

2.2.1 DATA CONSIDERED

The data in the study included the following files:

MIDDLE GUST IV	DIAL PACK
4290	3437
	3431
	3445

The reader should consult Reference 4 for the identification of these data.

2.2.2 PROCESSING INSTRUCTIONS

The processing instructions as received on the Job Request Form are shown in Figure 2-12. Although an air-blast record was requested from event DIAL PACK by telephone, it was agreed that it would be replaced by a record from MIDDLE GUST IV, whose measurement duration more nearly matched the DIAL PACK velocity measurements.

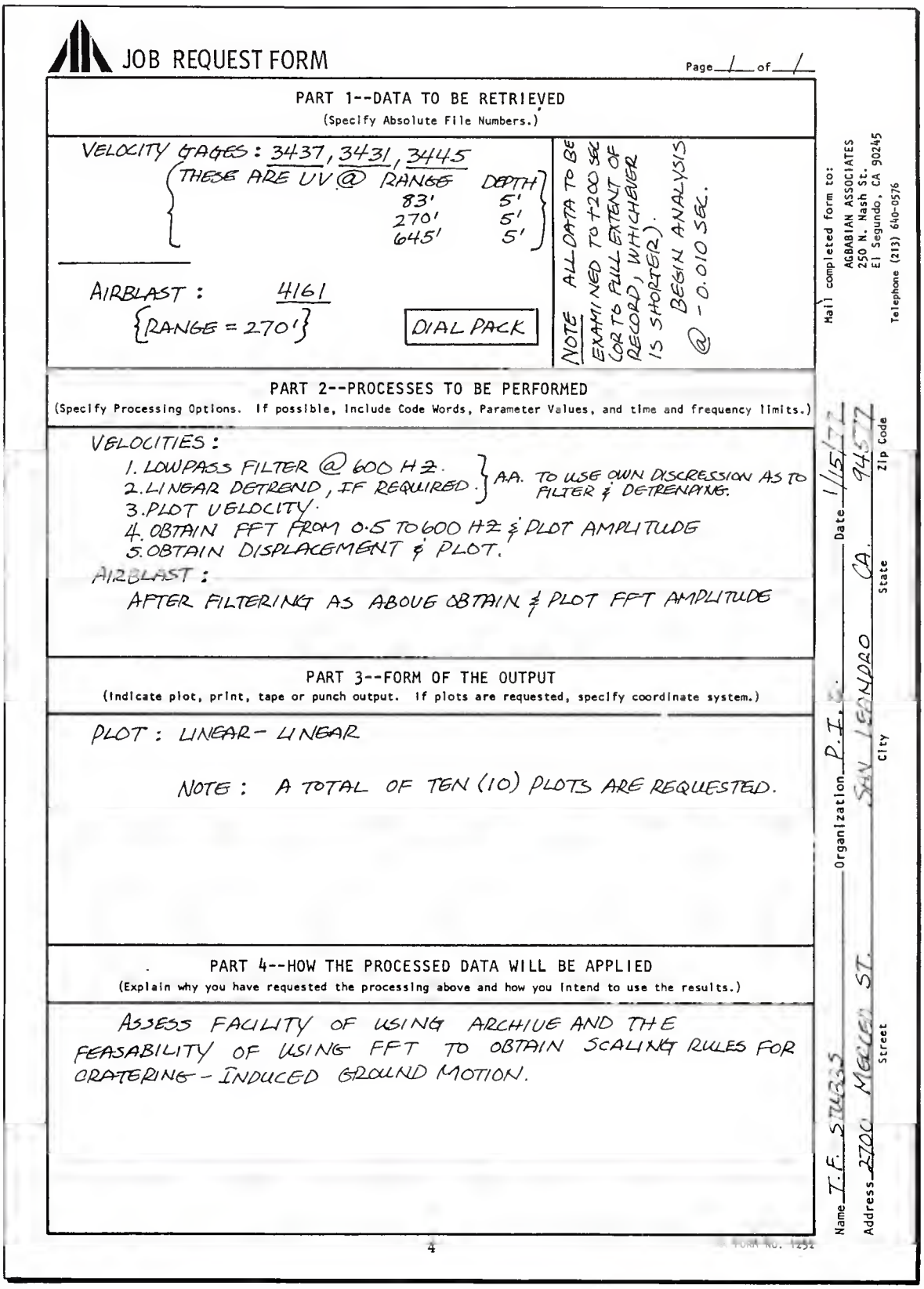
A study of Figure 2-12 indicates a rather detailed set of instructions for data to be extracted, processed, and displayed. The instructions included requirements to filter, linear detrend if necessary, integrate, and plot the resulting velocities and displacements. In addition, it was requested that the FFT amplitude be obtained for the velocity records.

A similar set of instructions was provided for the processing of the air-blast measurement.

2.2.3 PROCESSING SETUP AND ASSUMPTIONS

Prior to performing detrends of data, it is customary to plot the original records and their integrals to establish the character of the offsets or drifts displayed by the data. These plotted data are not part of the requested output, but they are shown in Figures 2-13 through 2-15 for instructive purposes. To conserve computer costs, the velocity records were filtered (to 600 Hz) with a 6-pole Butterworth, low-pass tangent filter, with a cutoff at 600 Hz, and decimated to a sampling rate of 1500 sps. No detrending or filter preload was included. The interested reader will want to compare the parameters of the TFILLP option in Reference 4 with the printed output in Figures 2-13 through 2-15.

A review of the air-blast measurement (File 4290) in Reference 8 suggested that no detrending would be required; hence, this measurement was not initially plotted.



JOB REQUEST FORM

Page 1 of 1

PART 1--DATA TO BE RETRIEVED
(Specify Absolute File Numbers.)

VELOCITY GAGES: 3437, 3431, 3445
THESE ARE UV @ RANGE DEPTH
83' 5'
270' 5'
645' 5'

AIRBLAST: 4161
{RANGE = 270'}

DIAL PACK

NOTE ALL DATA TO BE EXAMINED TO T+200 SEC (OR TO FULL EXTENT OF RECORD, WHICHEVER IS SHORTER). BEGIN ANALYSIS @ -0.010 SEC.

PART 2--PROCESSES TO BE PERFORMED
(Specify Processing Options. If possible, include Code Words, Parameter Values, and time and frequency limits.)

VELOCITIES:
1. LOWPASS FILTER @ 600 HZ.
2. LINEAR DETREND, IF REQUIRED. } AA. TO USE OWN DISCRESSION AS TO FILTER & DETRENDING.
3. PLOT VELOCITY.
4. OBTAIN FFT FROM 0.5 TO 600 HZ & PLOT AMPLITUDE
5. OBTAIN DISPLACEMENT & PLOT.

AIRBLAST:
AFTER FILTERING AS ABOVE OBTAIN & PLOT FFT AMPLITUDE

PART 3--FORM OF THE OUTPUT
(Indicate plot, print, tape or punch output. If plots are requested, specify coordinate system.)

PLOT: LINEAR - LINEAR

NOTE: A TOTAL OF TEN (10) PLOTS ARE REQUESTED.

PART 4--HOW THE PROCESSED DATA WILL BE APPLIED
(Explain why you have requested the processing above and how you intend to use the results.)

ASSESS FACILITY OF USING ARCHIVE AND THE FEASABILITY OF USING FFT TO OBTAIN SCALING RULES FOR CRATERING - INDUCED GROUND MOTION.

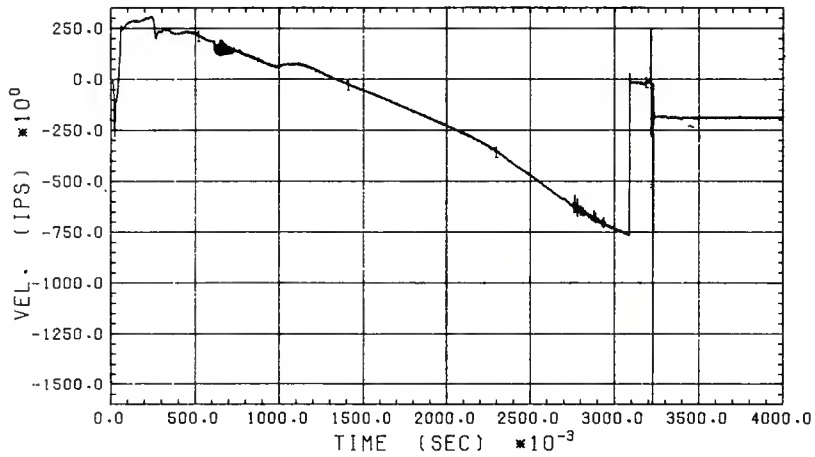
Mail completed form to:
AGBABIAN ASSOCIATES
250 N. Nash St.
El Segundo, CA 90245
Telephone (213) 640-0576

Name T.F. STRAUS Organization P.I. Date 1/15/82
Address 2700 MAGUIRE ST. SAN LEANDRO CA. 94577
Street City State Zip Code

4

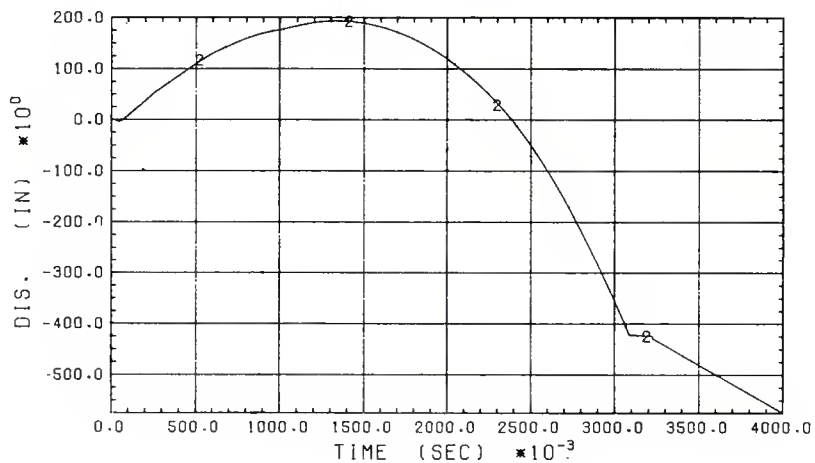
FORM NO. 1252

FIGURE 2-12 PHYSICS INTERNATIONAL PROCESSING REQUEST



(a) Velocity

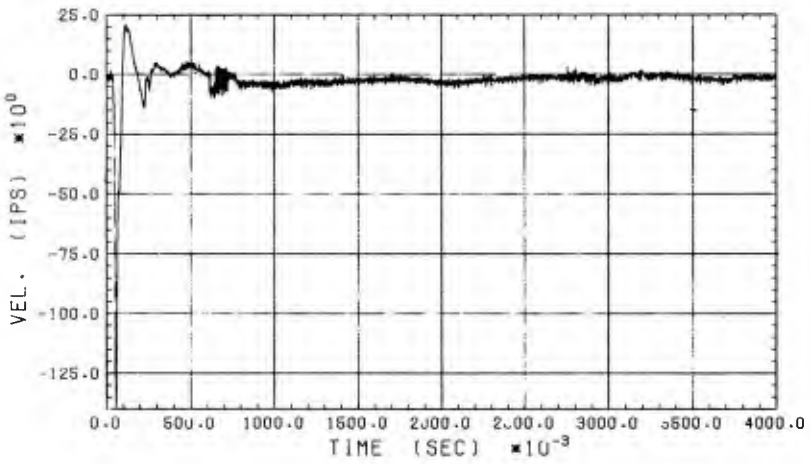
```
CURVE 1     PAGE 2
44FEVV005A215R083    V L                  83-5-UV              WES
1.5001E+03                          -1.5923E+03       3.0875E+02
0.0000E+00       3.9992E+00         -1.5923E+03       3.0875E+02
3-5-UV      DIAL PACK
 TFILLP     0.0000E+00  8.0000E+00  6.0000E+02  0.0000E+00  0.0000E+00
            0.0000E+00                    4935        3437        3437
```



(b) Displacement

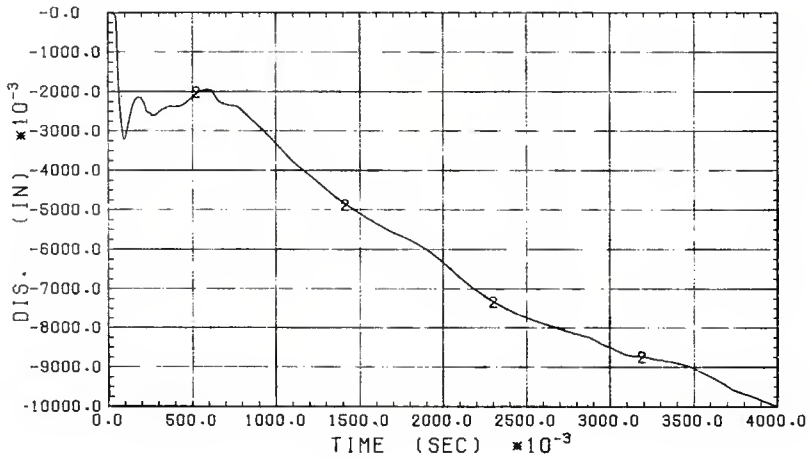
```
CURVE 2     PAGE 2
44FEVV005A215R083    D LI                 83-5-UV              WES
1.5001E+03                          -5.7455E+02       1.9331E+02
0.0000E+00       3.9992E+00         -5.7455E+02       1.9331E+02
3-5-UV      DIAL PACK
 TFILLP     0.0000E+00  8.0000E+00  6.0000E+02  0.0000E+00  0.0000E+00
            0.0000E+00                    4936        3437        3437
 PINT       0.0000E+00
                                          4936        3437        3437
```

FIGURE 2-13. PRELIMINARY OUTPUT FOR FILE 3437



(a) Velocity

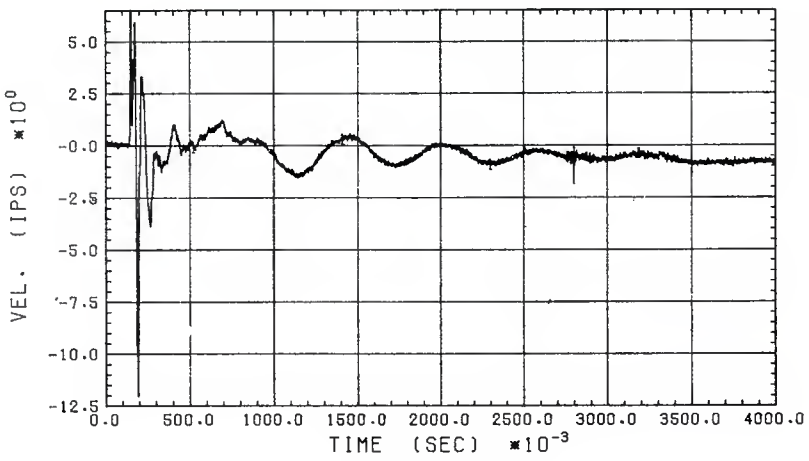
CURVE 1 PAGE 1
44FEVV005A215R270 V L 270-5-UV WES-
1.5001E+03 -1.4018E+02 2.0842E+01
0.0000E+00 3.9992E+00 -1.4018E+02 2.0842E+01
70-5-UV DIAL PACK
TFILLP 0.0000E+00 8.0000E+00 6.0000E+02 0.0000E+00 0.0000E+00
0.0000E+00 4933 3431 3431



(b) Displacement

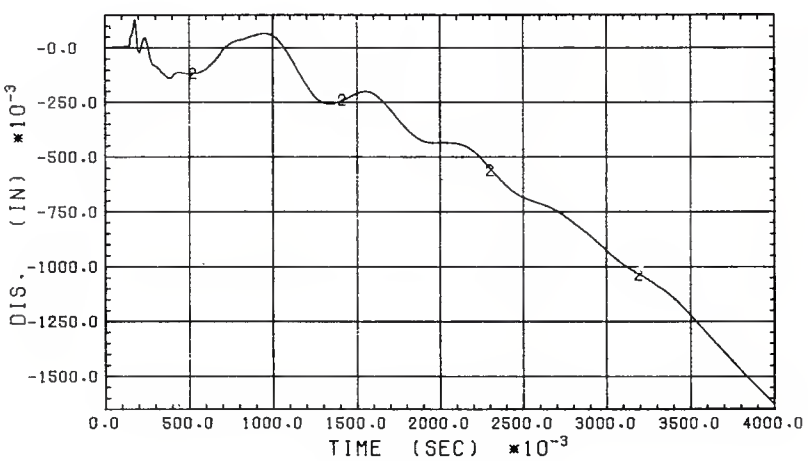
CURVE 2 PAGE 1
44FEVV005P215R270 D LI 270 5-UV WES
1.5001E+03 -9.9934E+00 8.9319E-05
0.0000E+00 3.9992E+00 -9.9934E+00 8.9319E-05
70-5-UV DIAL PACK
TFILLP 0.0000E+00 8.0000E+00 6.0000E+02 0.0000E+00 0.0000E+00
0.0000E+00 4923 3431 3431
PINT 0.0000E+00
4934 3431 3431

FIGURE 2-14. PRELIMINARY OUTPUT FOR FILE 3431




```
CURVE 1    PAGE 3
44FEVV005A215R645    V L                645-5-UV          WES
1.5001E+03                         -1.2061E+01      6.4898E+00
0.0000E+00      3.9992E+00         -1.2061E+01      6.4898E+00
45-5-UV    DIAL PACK
 TFILLP    0.0000E+00  8.0000E+00  6.0000E+02  0.0000E+00  0.0000E+00
           0.0000E+00                    4937        3445        3445
```

(a) Velocity




```
CURVE 2    PAGE 3
44FEVV005A215R645    D LI               645-5-UV          WES
1.5001E+03                         -1.6278E+00      1.2825E-01
0.0000E+00      3.9992E+00         -1.6278E+00      1.2825E-01
45-5-UV    DIAL PACK
 TFILLP    0.0000E+00  8.0000E+00  6.0000E+02  0.0000E+00  0.0000E+00
           0.0000E+00                    4927        3445        3445
 PINT      0.0000E+00
                                         4938        3445        3445
```

(b) Displacement

FIGURE 2-15. PRELIMINARY OUTPUT FOR FILE 3445

Based on the results of the information in Figures 2-13 through 2-15, it was elected not to detrend File 3437. File 3431 was detrended by removing the mean value of the preground shock signal from the entire record. File 3445 was detrended with a linear-least-squares correction applied to the entire record.

The rationale of the foregoing was based on the fact that File 3437 was a record so near to ground zero that it was in the region of large permanent deformation, and a detrend procedure could not be justified without an understanding of the physics of the phenomenon. Since a detailed analysis of phenomenology was beyond the scope of the present work, the record was accepted as it was recorded.

The measurement on File 3431 was sufficiently close to the detonation point that permanent displacement had occurred. Thus, only the detectable offset error was removed from the data. Conversely, File 3445 represented a measurement sufficiently removed from ground zero to preclude permanent displacement and the entire record was detrended, thus returning its displacement to zero in late time. All detrends were performed with the DETN option.

None of the discussion above should be construed as a final recommendation for detrending these data; rather, it should be viewed as one of perhaps many rational procedures that could be applied.

The air-blast measurement (File 4290) had its time base increased by the cube root scaling law so that the 100-ton MIDDLE GUST data could be compared directly to the 500-ton DIAL PACK data. Thus, the time base of File 4290 was increased (with the PTIMMU option) by the factor $(W_{DP}/W_{MG})^{1/3} = (5)^{1/3} \simeq 1.708$.

Subsequent to the filtering and detrending, FFTs of the velocity and air-blast records were calculated using the FOUR option. The record lengths used were 3000 points or two seconds. A cosine bell taper was applied to the last 10% of the data (see Ref. 4 for details of FFT operations). The real and imaginary components of the FFT in FOUR option were converted to amplitude and phase in the CPOL option.

2.2.4 OUTPUT

The plotted output for the three velocity measurements are presented in Figures 2-16 through 2-18, and for the pressure measurement in Figure 2-19. They show the fully processed records and their integrations (for the velocity measurements), together with the FFT amplitudes.

2.2.5 REQUESTOR'S COMMENTS

The data in Figures 2-13 through 2-19 were presented to the requestor together with printed output too voluminous for inclusion here. The requestor indicated that he had intended to have the FFT amplitudes presented in logarithmic coordinates and would request such scales in the future.

2.2.6 CONCLUSIONS

The work performed for this Archive user required the most extensive series of operations in data processing. The reader is encouraged to study the results presented in Section 2.2.4, together with the processing discussions presented in Section 2.2.3, prior to performing similar operations.

2.3 FIRST REQUEST FROM THE BOEING AEROSPACE COMPANY

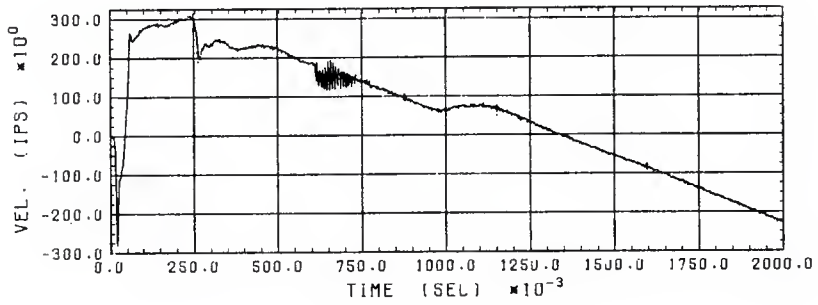
A standard request was received from the Boeing Aerospace Company for the processing of air-blast and structure velocity measurements to support the MX program. The processing requests consisted of filtering, detrending, Fourier transformation, and the production of shock spectra.

2.3.1 DATA CONSIDERED

The data in the study included the following files:

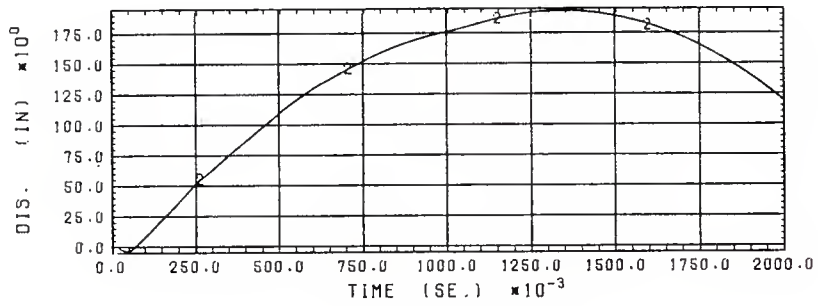
MIXED COMPANY	
4325	2486
4326	2558
4725	2549
4728	2463

The reader should consult Reference 4 for the identification of these data.



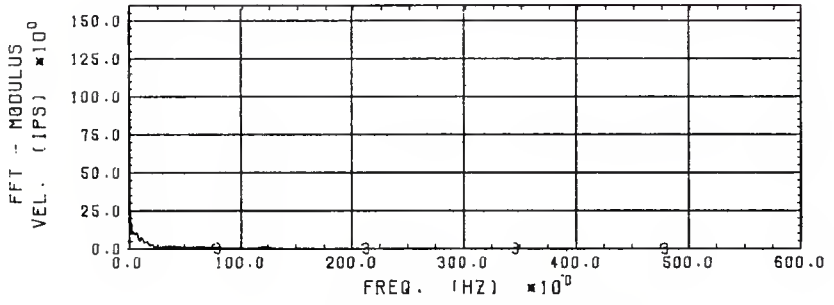
(a) Velocity

```
CURVE 1    PAGE 3
44FEVV005A215R083   V L                    83-5-UV            WES
1.5001E+03                          -2.8105E+02      3.0875E+02
0.0000E+00      1.9999E+00          -2.8105E+02      3.0875E+02
3-5-UV     DIAL PACK
 TFILLP   0.0000E+00  8.0000E+00  6.0000E+02  0.0000E+00  0.0000E+00
          0.0000E+00                          0        4935        3437
```



(b) Displacement

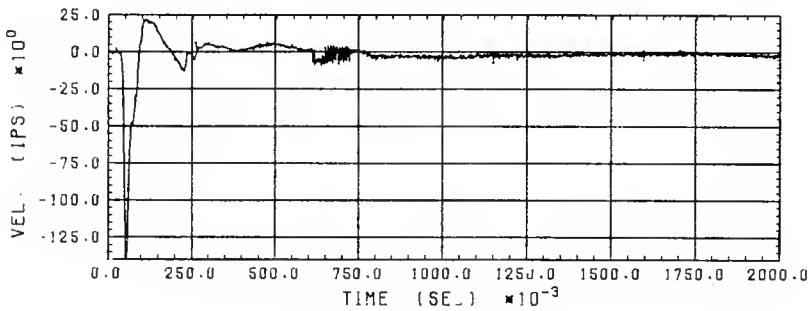
```
CURVE 2    PAGE 3
44FEVV005A215R083   D LI                   83-5-UV            WES
1.5001E+03                          -3.6581E+00      1.9331E+02
0.0000E+00      1.9999E+00          -3.6581E+00      1.9331E+02
3-5-UV     DIAL PACK
 TFILLP   0.0000E+00  8.0000E+00  6.0000E+02  0.0000E+00  0.0000E+00
          0.0000E+00                          0        4935        3437
 PINT     0.0000E+00
                                              0        4935        3437
```



(c) FFT Amplitude of (a)

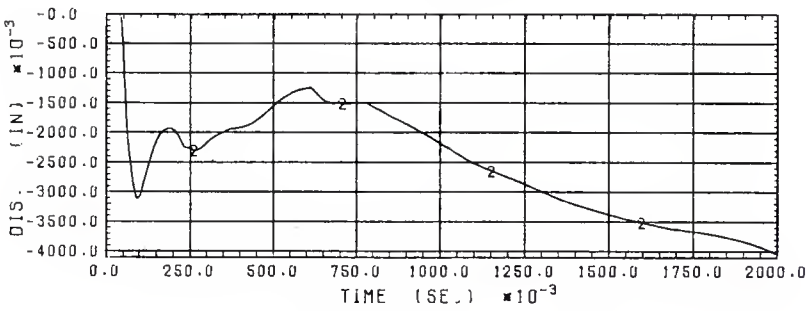
```
CURVE 3    PAGE 3
44FEVV005A215R083   FV LAF                 83-5-UV            WES
1.9999E+00                          4.0847E-03      1.5835E+02
0.0000E+00      5.9952E+02          4.0847E-03      1.5835E+02
3-5-UV     DIAL PACK
 TFILLP   0.0000E+00  8.0000E+00  6.0000E+02  0.0000E+00  0.0000E+00
          0.0000E+00                          4945        4935        3437
 F0UR     3.0000E+03  4.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
                                              4945        4935        3437
 CP0L     0.0000E+00
                                              4945        4935        3437
```

FIGURE 2-16. FINAL OUTPUT FOR FILE 3437



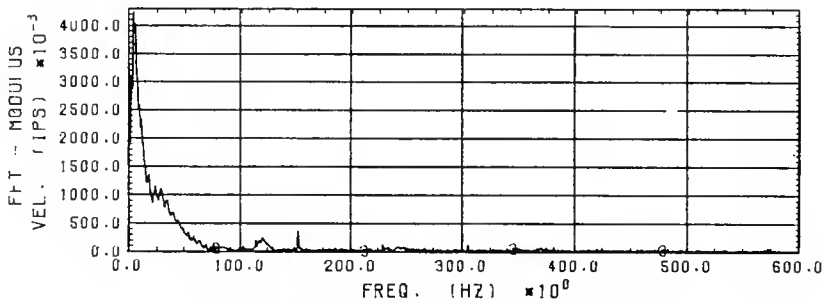
(a) Velocity

```
CURVE 1    PAGE 1
44FEVV005A215R270    V LT                270-5-UV          WES
1.5001E+03                          -1.3903E+02      2.1991E+01
0.0000E+00      1.9999E+00          -1.3903E+02      2.1991E+01
70-5-UV    DIAL PACK
 TF.LLP    0.0000E+00  8.0000E+00  6.0000E+02  0.0000E+00  0.0000E+00
           0.0000E+00                    4941        4933        3431
 DETN      0.0000E+00  0.0000E+00  3.1000E+01
                                         4941        4933        3431
```



(b) Displacement

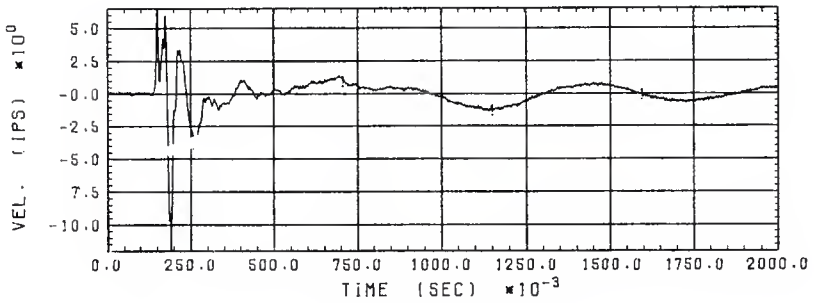
```
CURVE 2    PAGE 1
44FEVV005A215R270    D LTI               270-5-UV          WES
1.5001E+03                          -4.0400E+00      3.2960E-03
0.0000E+00      1.9999E+00          -4.0400E+00      3.2960E-03
70-5-UV    DIAL PACK
 TFILLP    0.0000E+00  8.0000E+00  6.0000E+02  0.0000E+00  0.0000E+00
           0.0000E+00                       0        4933        3431
 DETN      0.0000E+00  0.0000E+00  3.1000E+01
                                          0        4933        3431
 PINT      0.0000E+00
                                          0        4933        3431
```



(c) FFT Amplitude of (a)

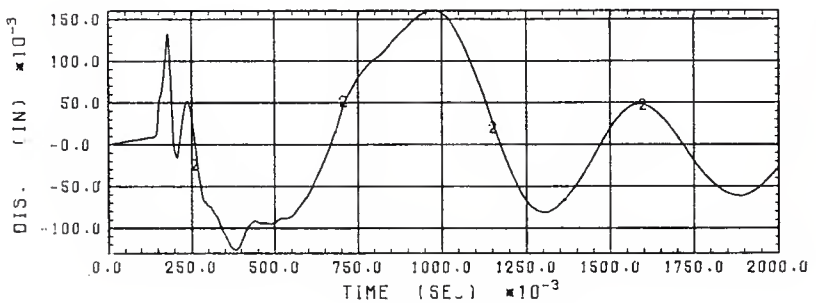
```
CURVE 3    PAGE 1
44FEVV005A215R270  FV LTAF             270-5-UV          WES
1.9999E+00                          6.5058E-04      4.2319E+00
0.0000E+00      5.9952E+02          6.5058E-04      4.2319E+00
70-5-UV    DIAL PACK
 TFILLP    0.0000E+00  8.0000E+00  6.0000E+02  0.0000E+00  0.0000E+00
           0.0000E+00                    4942        4933        3431
 DETN      0.0000E+00  0.0000E+00  3.1000E+01
                                         4942        4933        3431
 FBUR      3.0000E+03  4.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
                                         4942        4933        3431
 CPBL      0.0000E+00
                                         4942        4933        3431
```

FIGURE 2-17. FINAL OUTPUT FOR FILE 3431



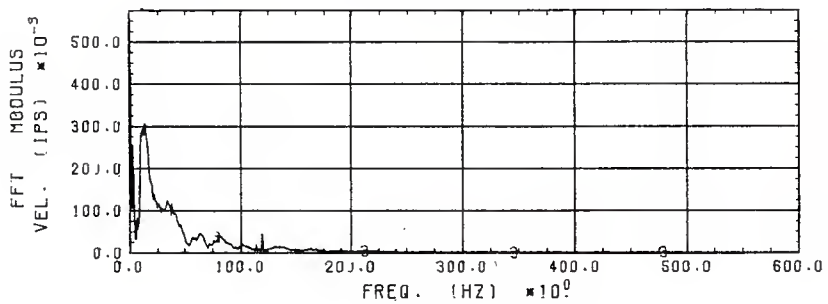
(a) Velocity

```
CURVE 1     PAGE 2
44FEVV005A215R645    V LT                645-5-UV          WES
1.5001E+03                          -1.2022E+01      6.5207E+00
0.0000E+00      1.9999E+00          -1.2022E+01      6.5207E+00
45-5-UV    DIAL PACK
 TFILLP    0.0000E+00  8.0000E+00  6.0000E+02  0.0000E+00  0.0000E+00
           0.0000E+00                    4943        4937        3445
 DETN      1.0000E+00  0.0000E+00  0.0000E+00
                                         4943        4937        3445
```



(b) Displacement

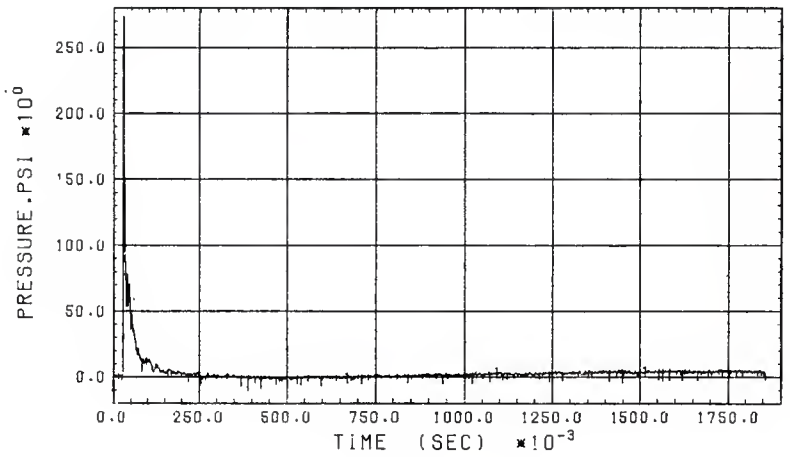
```
CURVE 2     PAGE 2
44FEVV005A215R645    D LTI               645-5-UV          WES
1.5001E+03                          -1.2604E-01      1.6011E-01
0.0000E+00      1.9999E+00          -1.2604E-01      1.6011E-01
45-5-UV    DIAL PACK
 TFILLP    0.0000E+00  8.0000E+00  6.0000E+02  0.0000E+00  0.0000E+00
           0.0000E+00                       0        4937        3445
 DETN      1.0000E+00  0.0000E+00  0.0000E+00
                                            0        4937        3445
 PINT      0.0000E+00
                                            0        4937        3445
```



(c) FFT Amplitude of (a)

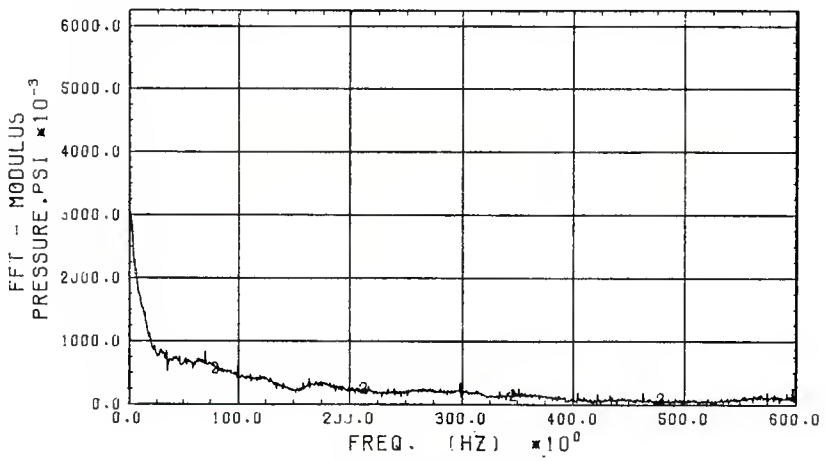
```
CURVE 3     PAGE 2
44FEVV005A215R645  FV LTAF             645-5-UV          WES
1.9999E+00                          4.3473E-05      5.6200E-01
0.0000E+00      5.9952E+02          4.3473E-05      5.6200E-01
45-5-UV    DIAL PACK
 TFILLP    0.0000E+00  8.0000E+00  6.0000E+02  0.0000E+00  0.0000E+00
           0.0000E+00                    4944        4937        3445
 DETN      1.0000E+00  0.0000E+00  0.0000E+00
                                         4944        4937        3445
 FBUR      3.0000E+03  4.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
                                         4944        4937        3445
 CPBL      0.0000E+00
                                         4944        4937        3445
```

FIGURE 2-18. FINAL OUTPUT FOR FILE 3445



(a) Airblast

```
CURVE 1     PAGE 1
048EPV000A330R160    P L0                RZ SHIFTED          DEV-F
1.5407E+03                          -1.0553E+01      3237359E+02
0.0000E+00      1.8582E+00          -1.0553E+01       2.7359E+02
E-L21-000-330-160-BP-V
 TFILLP    0.0000E+00  1.9000E+01  2.5650E+03  0.0000E+00  0.0000E+00
           0.0000E+00                       0        4909        4290
 PTIMMU    1.7080E+00
                                            0        4909        4290
```



(b) FFT Amplitude of (a)

```
CURVE 2     PAGE 1
048EPV000A330R160  FP LOAF              RZ SHIFTED          DEV-F
1.9471E+00                          8.3405E-03      3633224 E+00
0.0000E+00      5.9986E+02          8.3405E-03       6.2245E+00
E L21-000-330-160-BP-V
 TFILLP    0.0000E+00  1.9000E+01  2.5650E+03  0.0000E+00  0.0000E+00
           0.0000E+00                       0        4909        4290
 PTIMMU    1.7080E+00
                                            0        4909        4290
 FOUR      3.0000E+03  4.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00
                                            0        4909        4290
 CPOL      0.0000E+00
                                            0        4909        4290
```

FIGURE 2-19. FINAL OUTPUT FOR FILE 4290

2.3.2 PROCESSING INSTRUCTIONS

The processing instructions as received in the Job Request Form are shown in Figure 2-20. Due to program constraints, not all of the data requested to be processed could be included and only those listed in Section 2.3.1 were considered.

The instructions for processing the data are very complete. BAC foresaw the need to detrend and requested plots, the generation of Fourier spectra, and in some cases, the production of shock spectra.

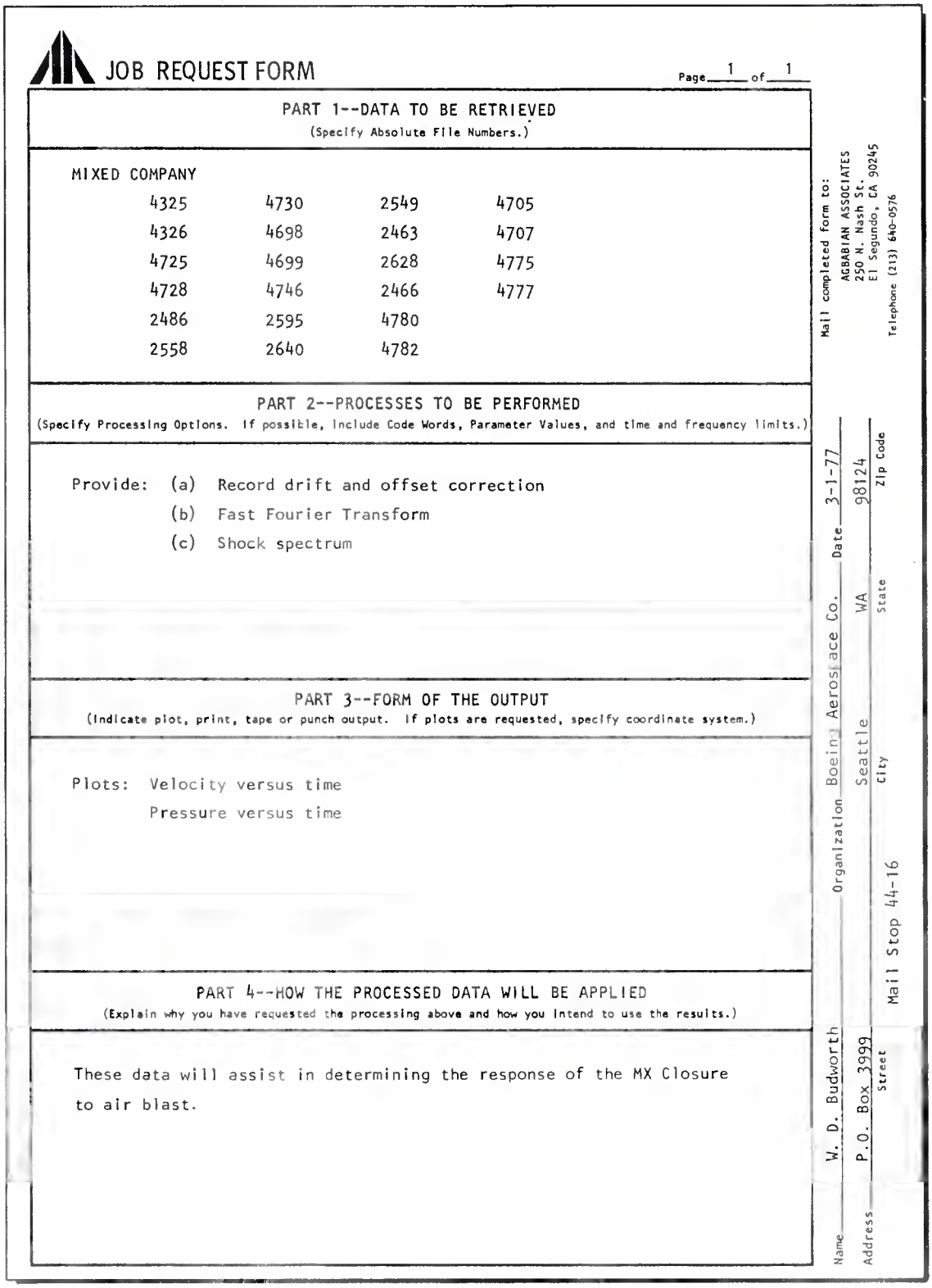
2.3.3 PROCESSING SETUP, ASSUMPTIONS, AND OUTPUT

As is the usual practice, all raw records were integrated to establish the characteristics of baseline errors in the data. Prior to plotting the original data and performing the integrations, they were filtered to 2000 Hz and decimated to a sampling rate of 5000 sps using the TFILLP option. A standard 6-pole Butterworth, low-pass tangent filter was used with no preload. The results, shown in Figures 2-21 and 2-22 for a selection of records,* represent typical measurement characteristics encountered in the study.

Based on the data presented in Figures 2-21 and 2-22 and in Appendix B, certain standard detrending procedures were implemented. Thus, in Figures 2-23 and 2-24, each record was detrended via the DETN option by fitting a sloped line to a section of the back of each record, extending the line into the early-time regime, and subtracting the line from the record.

In addition, the preshock arrival noise was removed by replacing the data with zeros (PSTC). For example, in Figure 2-23, the printed output associated with DETN indicates a line fitted to the data from the time 0.4 sec for 3000 data points (i.e., to a time of 1 sec), which was subsequently subtracted from the entire record. The PSTC option indicates that data were replaced by zeros beginning at time zero and extending to 0.066 sec.

*Note: Due to the volume of data involved, records in their various processed forms are presented in Appendix B.



JOB REQUEST FORM

Page 1 of 1

PART 1--DATA TO BE RETRIEVED
(Specify Absolute File Numbers.)

MIXED COMPANY

4325	4730	2549	4705
4326	4698	2463	4707
4725	4699	2628	4775
4728	4746	2466	4777
2486	2595	4780	
2558	2640	4782	

PART 2--PROCESSES TO BE PERFORMED
(Specify Processing Options. If possible, include Code Words, Parameter Values, and time and frequency limits.)

Provide: (a) Record drift and offset correction
(b) Fast Fourier Transform
(c) Shock spectrum

PART 3--FORM OF THE OUTPUT
(Indicate plot, print, tape or punch output. If plots are requested, specify coordinate system.)

Plots: Velocity versus time
Pressure versus time

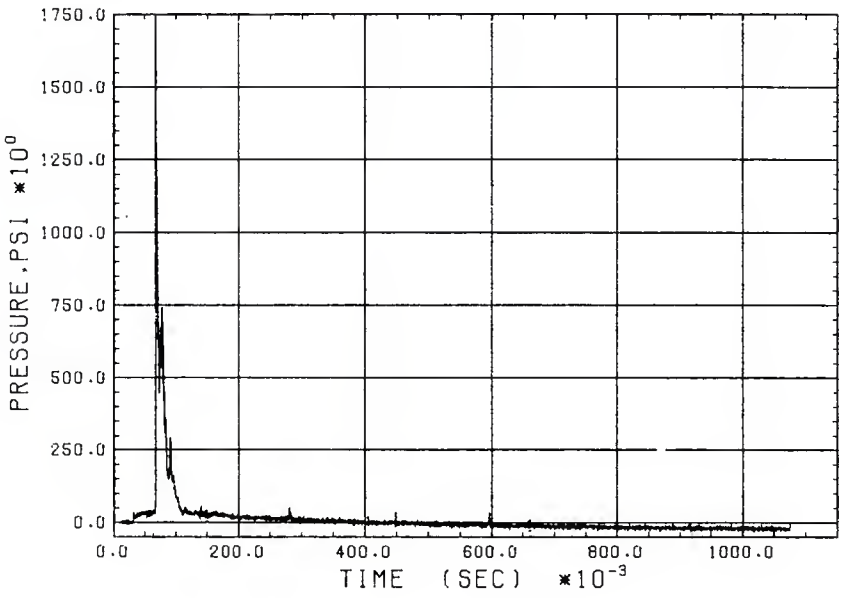
PART 4--HOW THE PROCESSED DATA WILL BE APPLIED
(Explain why you have requested the processing above and how you intend to use the results.)

These data will assist in determining the response of the MX Closure to air blast.

Mail completed form to:
AGBABIAN ASSOCIATES
250 N. Nash St.
El Segundo, CA 90245
Telephone (213) 640-0576

Name W. D. Budworth Organization Boeing Aerospace Co. Date 3-1-77
Address P.O. Box 3999 Seattle WA 98124
Street City State Zip Code
Mail Stop 44-16

FIGURE 2-20. THE BOEING AEROSPACE COMPANY PROCESSING REQUESTS




```
CURVE 1     PAGE 3
06BEPH-.5N6.0W3.7 I P L                    342 RZ 18.32      AFWL
5.0000E+03                          -3.2478E+01       1.7509E+03
0.0000E+00      1.1116E+00          -3.2478E+01       1.7509E+03
 M-E-ABS3-(-0.5)-6.0-3.75-BP-H A175R300 FROM GZ
 TFILLP    0.0000E+00  1.0000E+01  2.0000E+03  0.0000E+00  0.0000E+00
           0.0000E+00                    4948        4325        4325
```

FIGURE 2-21. FILE 4325 FILTERED, TFILLP, TO 2000 HZ AND DECIMATED TO 5000 SAMPLES/SECOND

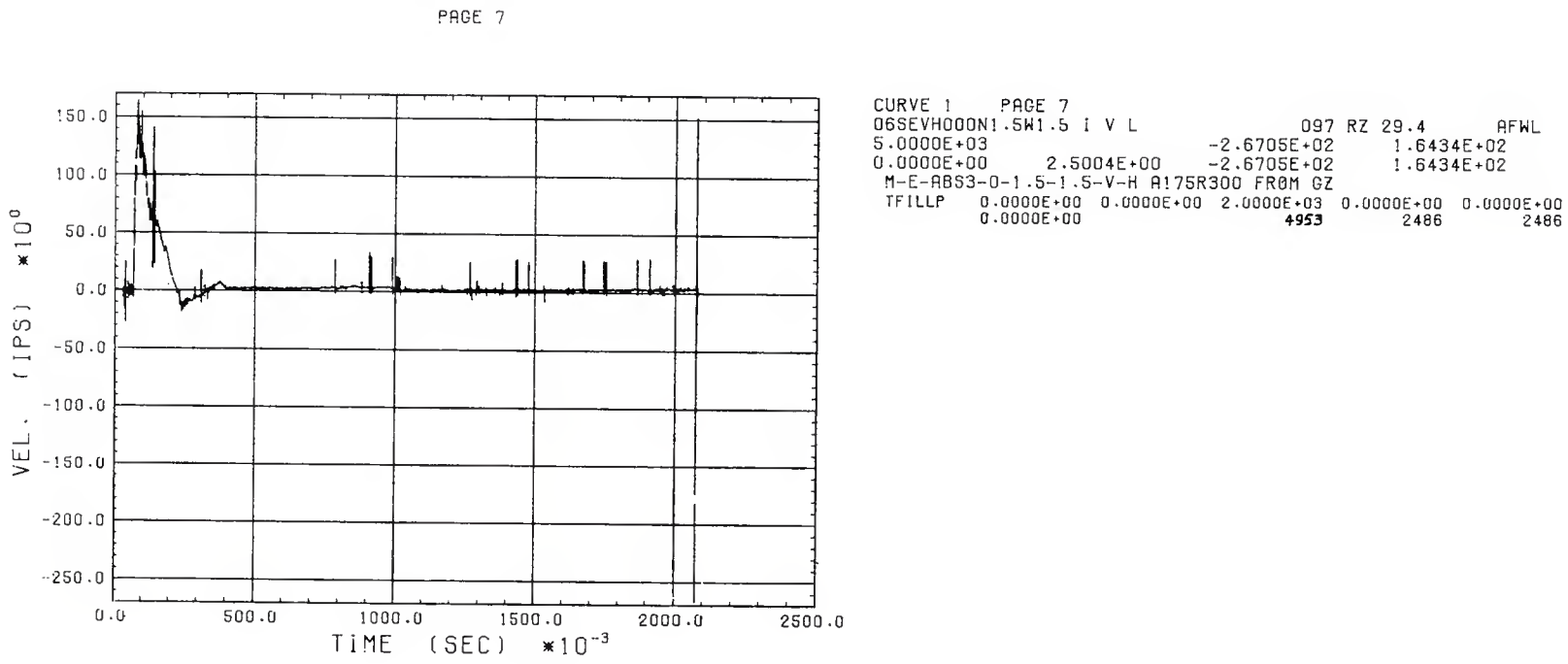
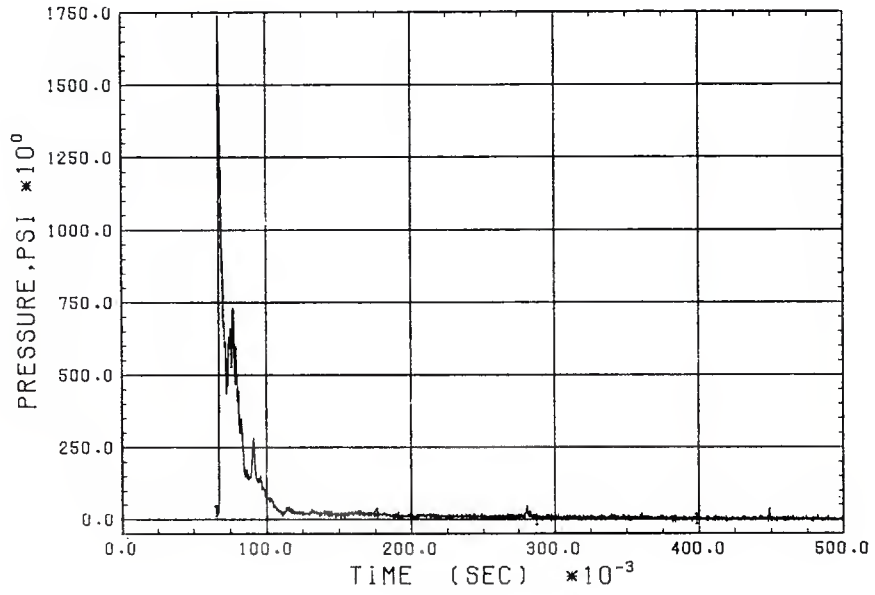


FIGURE 2-22. FILE 2486 FILTERED, TFILLP, TO 2000 HZ

PAGE 16

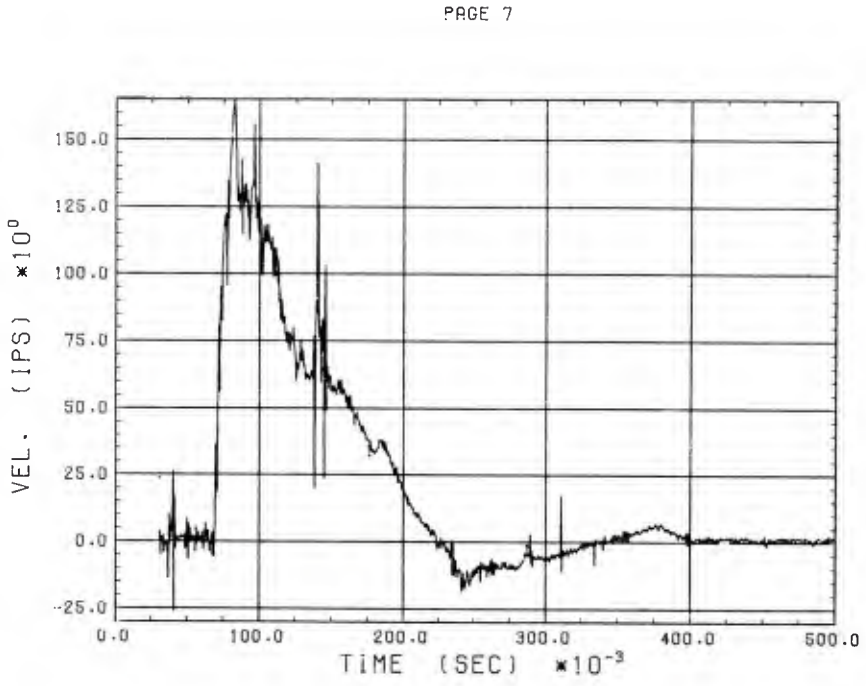


CURVE 1 PAGE 16
06BEPH-.5N6.0W3.7 I P LTS 342 RZ 18.32 AFWL
5.0000E+03 -1.2194E+01 1.7403E+03
0.0000E+00 5.0000E-01 -1.2194E+01 1.7403E+03
M-E-ABS3-(-0.5)-6.0-3.75-BP-H A175R300 FR0M GZ

TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		4959	4948	4325
DETN	1.0000E+00	4.0000E-01	3.0000E+03		
			4959	4948	4325
PSTC	0.0000E+00	0.0000E+00	6.6000E-02		
			4959	4948	4325

NOTE: DETN, WITH A LINEAR LEAST SQUARES FIT TO DATA FROM TIME BETWEEN 0.4 AND 1.0 SECONDS AND LINE EXTENDED BACK INTO AND REMOVED FROM TIME 0 TO 0.5 SECONDS. PRESHOCK ARRIVAL NOISE HAS BEEN REMOVED FROM RECORD, PSTC

FIGURE 2-23. FILE 4325 DETRENDED



CURVE 1 PAGE 7
06SEVH000N1.5W1.5 I V LTS 097 RZ 29.4 AFWL
5.0000E+03 -2.6266E+01 1.6510E+02
0.0000E+00 5.0000E-01 -2.6266E+01 1.6510E+02
M-E-ABS3-0-1.5-1.5-V-H A175R300 FROM GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		4956	4953	2486
DETN	1.0000E+00	6.0000E-01	2.0000E+03		
			4956	4953	2486
PSTC	0.0000E+00	0.0000E+00	3.1000E-02		
			4956	4953	2486

NOTE: DETN, WITH A LINEAR LEAST SQUARES FIT TO DATA FROM TIME BETWEEN 0.6 AND 1.0 SECONDS AND LINE EXTENDED BACK INTO AND REMOVED FROM TIME 0 TO 0.5 SECONDS. PRESHOCK ARRIVAL NOISE HAS BEEN REMOVED FROM RECORD, PSTC

FIGURE 2-24. FILTERED FILE 2486 DETRENDED

Figures 2-25 and 2-26 present integrations of the records shown in Figures 2-21 through 2-24 to indicate the effect of detrending on the data.

Figures 2-27 and 2-28 show the fast Fourier amplitudes of the records presented in Figures 2-23 and 2-24. The transform was calculated (FOUR) for a record length of 2500 points (0.5 sec), with a cosine taper applied to the end of the records. As before, the real and imaginary components produced by FOUR were converted to amplitude and phase via CPOL. Only the amplitudes are presented.

Finally, shock spectra were computed for motion records and an example is presented in Figure 2-29. This figure shows a different format of plotted output that is used when it is desirable to control the size of the plotted frame. This figure size matches the format of standardized tripartite shock spectra grids. The shock spectra are calculated using the SHOXVE option in which 40 logarithmically equally spaced frequency intervals were computed for the forced era of each record and with no damping.

2.3.4 REQUESTOR'S COMMENTS

At the writing of this document no comments concerning the processed data were received.

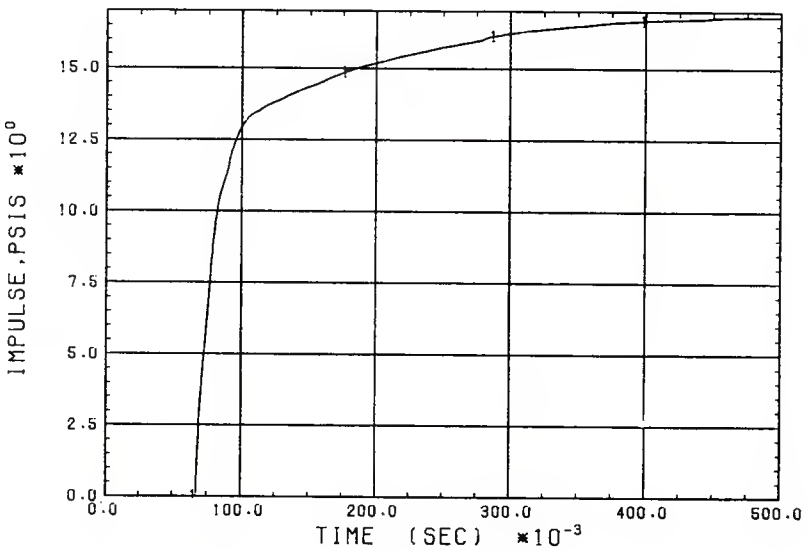
2.3.5 CONCLUSIONS

The work discussed for the Boeing Aerospace Company closely parallels the work performed for Physics International and R&D Associates. Somewhat different plotting formats have been utilized to satisfy the presumed needs of the user.

2.4 SECOND REQUEST FROM THE BOEING AEROSPACE COMPANY

A second Job Request Form was received from the Boeing Aerospace Company for the processing of air-blast and particle acceleration and velocity measurements to be performed in connection with the Deep Basing program. The requested processing involved detrending, Fourier transformation, integration, and the generation of shock spectra.

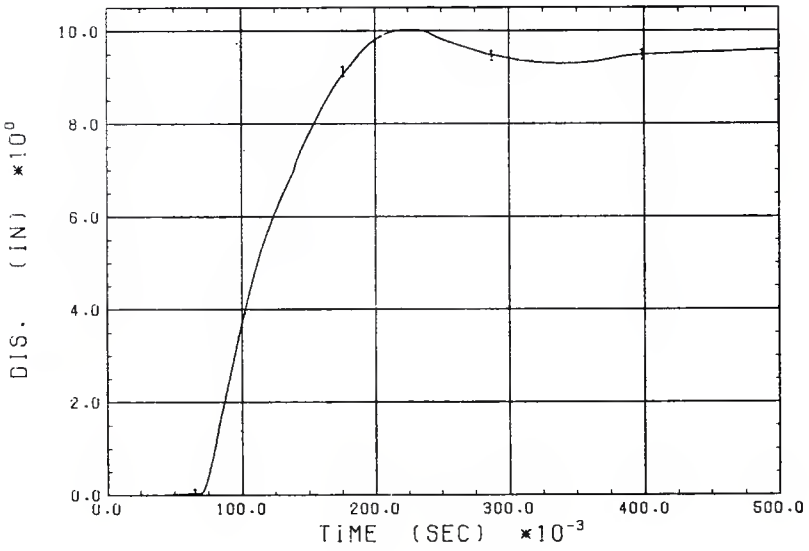
PAGE 17



CURVE 1 PAGE 17
06BEPH-.5N6.0W3.7 I I LTSI 342 RZ 18.32 AFWL
5.0000E+03 0.0000E+00 1.6826E+01
0.0000E+00 5.0000E-01 0.0000E+00 1.6826E+01
M-E-ABS3-(-0.5)-6.0-3.75-BP-H A175R300 FR0M GZ

TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4948	4325
DETN	1.0000E+00	4.0000E-01	3.0000E+03		
			0	4948	4325
PSTC	0.0000E+00	0.0000E+00	6.6000E-02		
			0	4948	4325
PINT	0.0000E+00				
			0	4948	4325

FIGURE 2-25. CLEANED-UP FILE 4325 INTEGRATED, PINT, TO OBTAIN IMPULSE

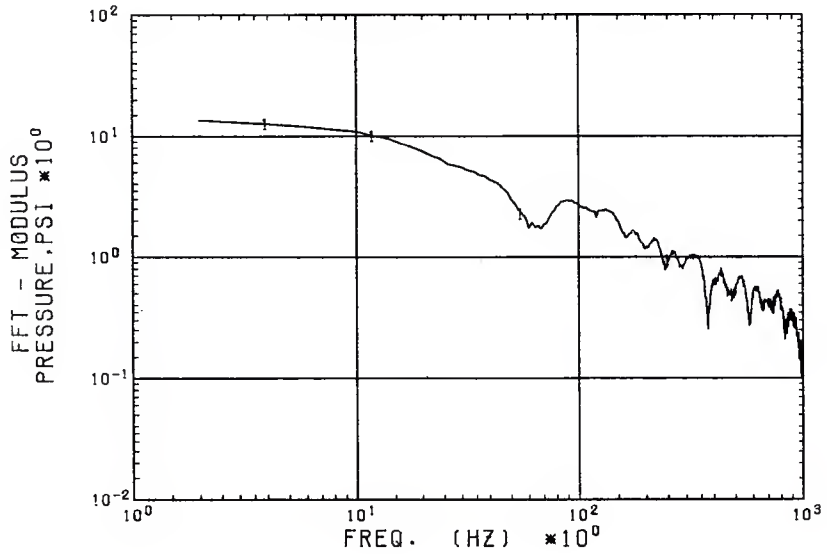


CURVE 1 PAGE 8
06SEVH0OON1.5W1.5 I D LTSI 097 RZ 29.4 AFWL
5.0000E+03 -9.4256E-03 1.0030E+01
0.0000E+00 5.0000E-01 -9.4256E-03 1.0030E+01
M-E-ABS3-O-1.5-1.5-V-H A175R300 FROM GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00	
	0.0000E+00		0	4953	2486	
DETN	1.0000E+00	6.0000E-01	2.0000E+03			
			0	4953	2486	
PSTC	0.0000E+00	0.0000E+00	3.1000E-02			
			0	4953	2486	
PINT	0.0000E+00					
			0	4953	2486	

FIGURE 2-26. CLEANED-UP FILE 2486 INTEGRATED, PINT, TO OBTAIN DISPLACEMENT

PAGE 18

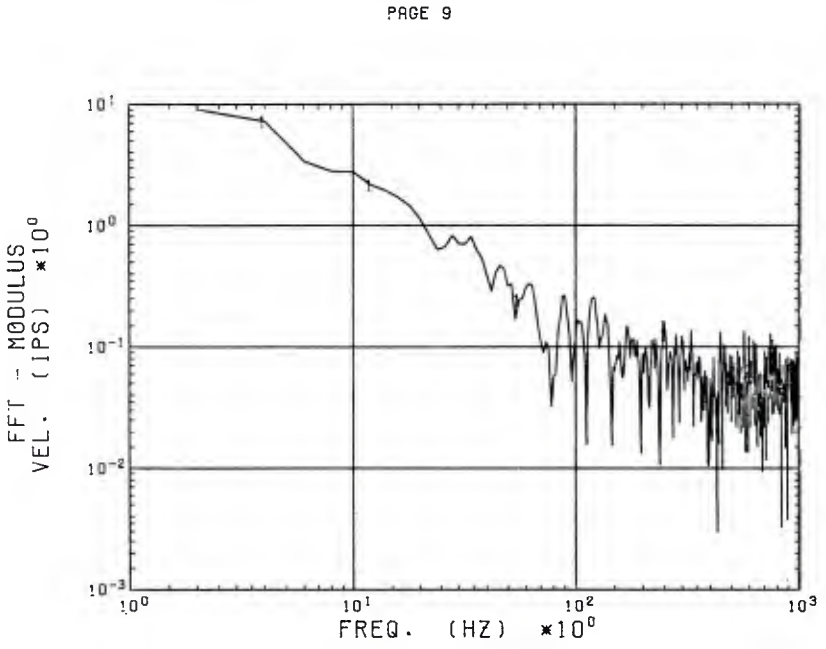


CURVE 1 PAGE 18

06BEPH-.5N6.0W3.7 IFP LTSAF 342 RZ 18.32 AFWL

5.0000E-01		7.3115E-02	1.3545E+01		
2.0000E+00	1.0000E+03	7.3115E-02	1.3545E+01		
M-E-ABS3-(-0.5)-6.0-3.75-BP-H A175R300 FROM GZ					
TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4948	4325
DETN	1.0000E+00	4.0000E-01	3.0000E+03		
			0	4948	4325
PSTC	0.0000E+00	0.0000E+00	6.6000E-02		
			0	4948	4325
FOUR	2.5000E+03	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4948	4325
CPOL	0.0000E+00				
			0	4948	4325

FIGURE 2-27. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED UP FILE 4325 WITH REAR 10% OF RECORD COSINE TAPERED



CURVE 1 PAGE 9
06SEVHOOON1.5W1.5 IFV LTSAF 097 RZ 29.4 AFWL
5.0000E-01 2.9352E-03 9.0473E+00
2.0000E+00 1.0000E+03 2.9352E-03 9.0473E+00
M-E-ABS3-0-1.5-1.5-V-H A175R300 FROM GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00	
	0.0000E+00		0	4953	2486	
DETN	1.0000E+00	6.0000E-01	2.0000E+03			
			0	4953	2486	
PSTC	0.0000E+00	0.0000E+00	3.1000E-02			
			0	4953	2486	
FOUR	2.5000E+03	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
			0	4953	2486	
CPOL	0.0000E+00					
			0	4953	2486	

FIGURE 2-28. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP FILE 2486 WITH REAR 10% OF RECORD COSINE TAPERED

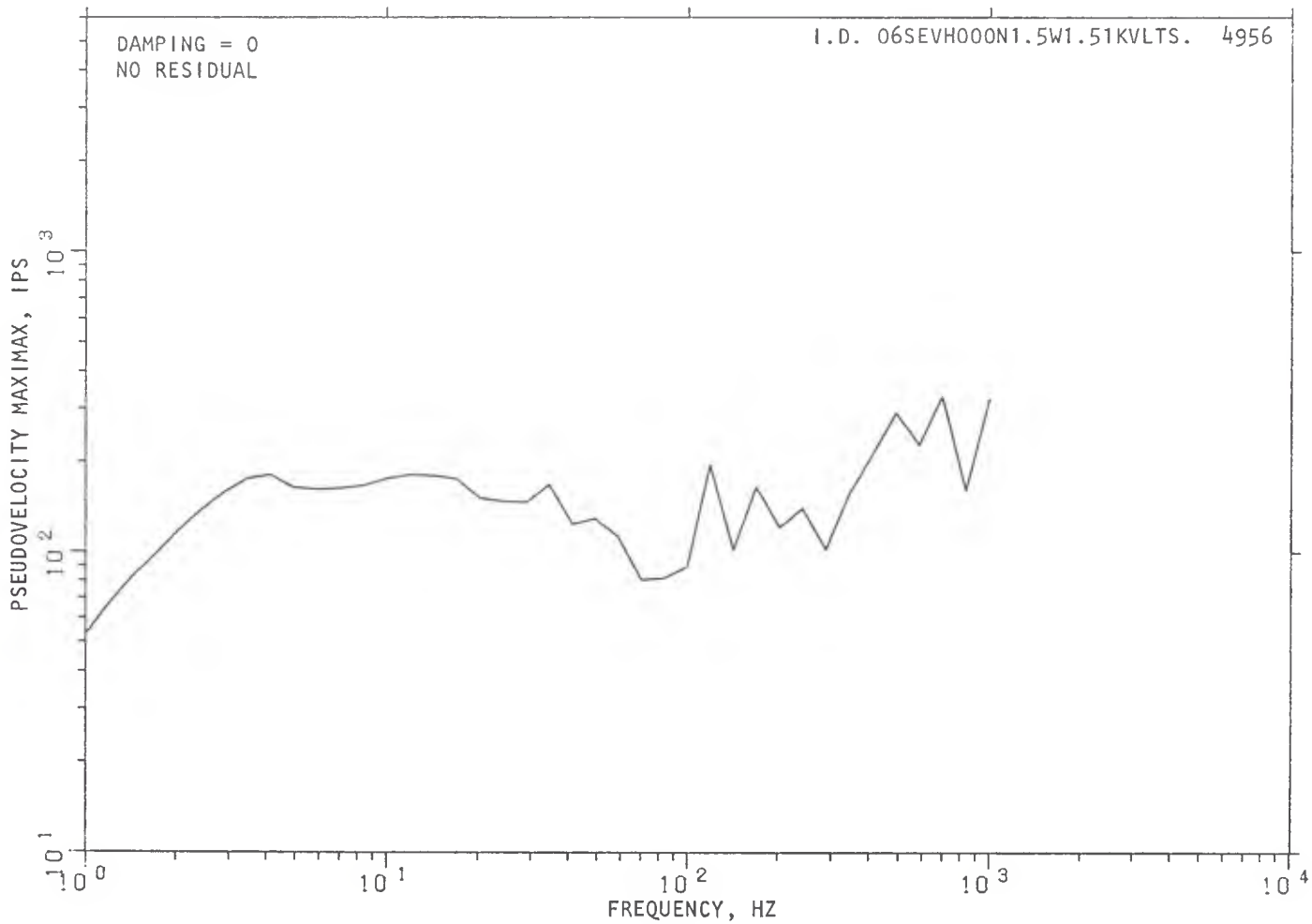


FIGURE 2-29. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP FILE 2486 WITH NO DAMPING AND NO RESIDUAL

2.4.1 DATA CONSIDERED

The data in the study consisted of the following files:

MINERAL ROCK		
2923	2919	4476
2924	2920	4477
3061	3059	4478
3062	3060	4479

The reader should consult Reference 4 for the identification of these data.

2.4.2 PROCESSING INSTRUCTIONS

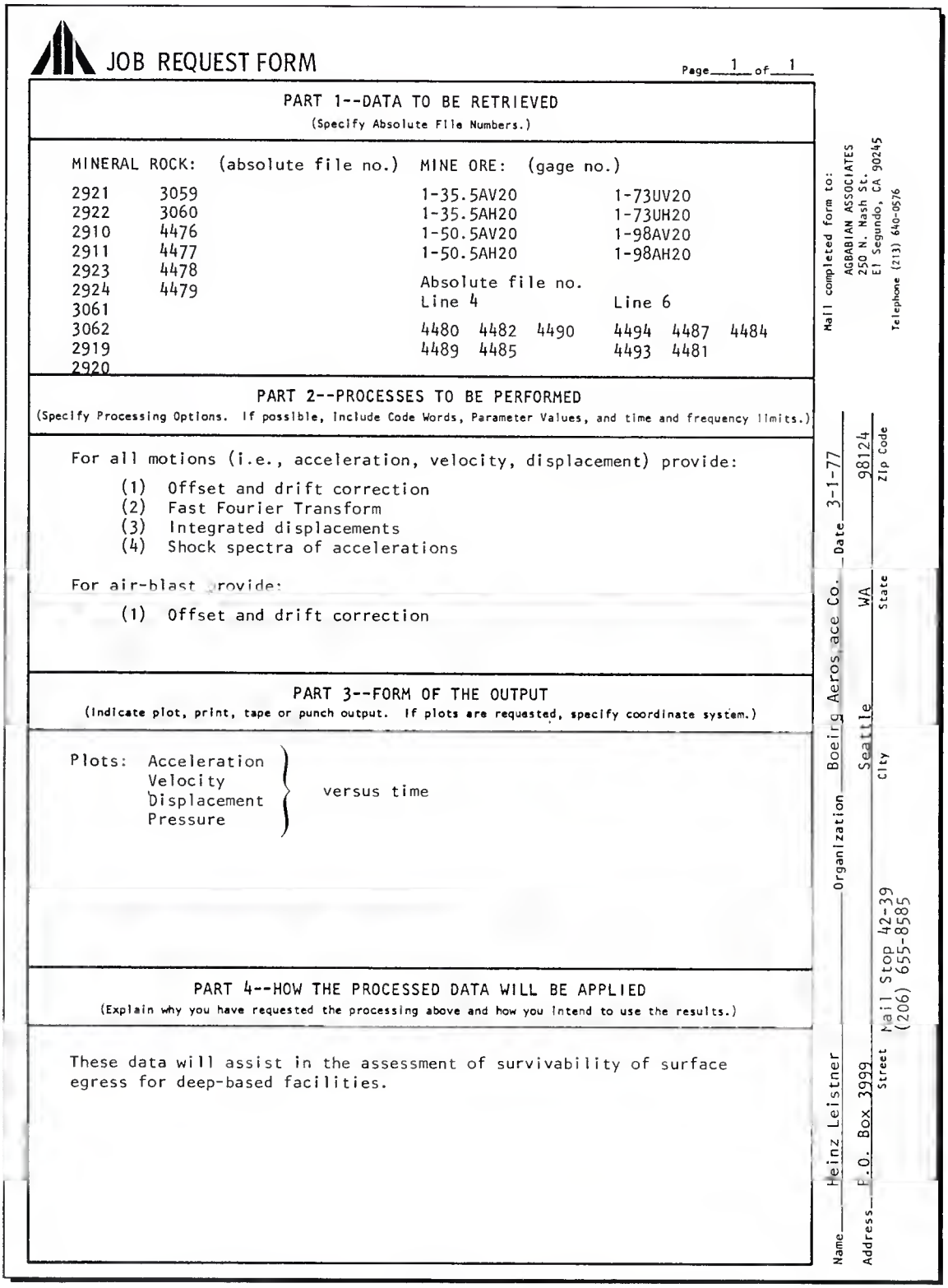
The processing instructions received on the Job Request Form are shown in Figure 2-30. Again, due to program restraints, not all of the data requested to be retrieved and processed could be included. The files that were processed are listed in Section 2.4.1.

As with the first Boeing request, the instructions for processing were quite detailed in that the need for detrending was foreseen along with provisions being made for plots and integrations, the calculation of Fourier transformations, and the generation of shock spectra.

2.4.3 PROCESSING SETUP, ASSUMPTIONS, AND OUTPUT

Prior to performing the requested detrend of the data, the original records and their integrals, excluding air-blast measurements, were plotted. These plotted data are not part of the requested output, but a representative sample is shown in Figures 2-31 through 2-33 for instructive purposes.* Before plotting the original data and generating the integrations, the records were lowpass filtered (TFILLP) to 2500 Hz, the accelerations and velocities were decimated to a sampling rate of 6000 sps and the air-blasts were decimated to 5000 sps.

*Note: Due to the volume of data involved, the complete set of records in their various processed forms are presented in Appendix C.



JOB REQUEST FORM

Page 1 of 1

PART 1--DATA TO BE RETRIEVED

(Specify Absolute File Numbers.)

MINERAL ROCK: (absolute file no.)

2921 3059
2922 3060
2910 4476
2911 4477
2923 4478
2924 4479
3061
3062
2919
2920

MINE ORE: (gage no.)

1-35.5AV20 1-73UV20
1-35.5AH20 1-73UH20
1-50.5AV20 1-98AV20
1-50.5AH20 1-98AH20

Absolute file no.

Line 4: 4480 4482 4490 4489 4485

Line 6: 4494 4487 4484 4493 4481

Mail completed form to:
AGBABIAN ASSOCIATES
250 N. Nash St.
El Segundo, CA 90245
Telephone (213) 640-0576

PART 2--PROCESSES TO BE PERFORMED

(Specify Processing Options. If possible, include Code Words, Parameter Values, and time and frequency limits.)

For all motions (i.e., acceleration, velocity, displacement) provide:

(1) Offset and drift correction
(2) Fast Fourier Transform
(3) Integrated displacements
(4) Shock spectra of accelerations

For air-blast provide:

(1) Offset and drift correction

Date 3-1-77

PART 3--FORM OF THE OUTPUT

(Indicate plot, print, tape or punch output. If plots are requested, specify coordinate system.)

Plots: Acceleration, Velocity, Displacement, Pressure } versus time

Organization Boeing Aerospace Co.

City Seattle State WA Zip Code 98124

PART 4--HOW THE PROCESSED DATA WILL BE APPLIED

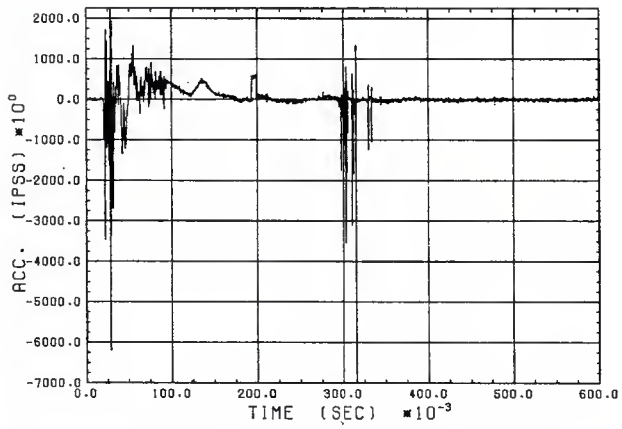
(Explain why you have requested the processing above and how you intend to use the results.)

These data will assist in the assessment of survivability of surface egress for deep-based facilities.

Name Heinz Leistner

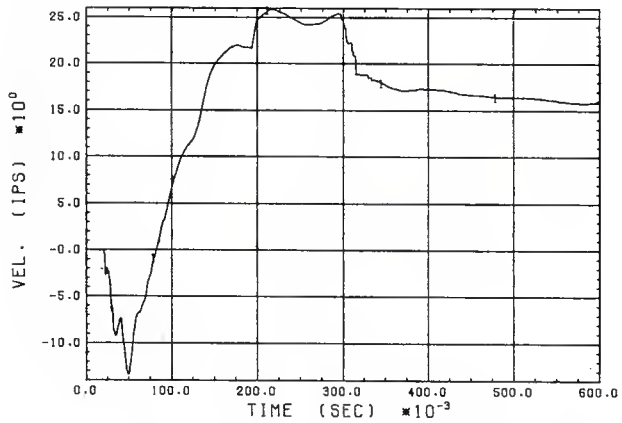
Address P.O. Box 3999 Street Mail Stop 42-39 (206) 655-8585

FIGURE 2-30. THE BOEING AEROSPACE COMPANY PROCESSING REQUESTS



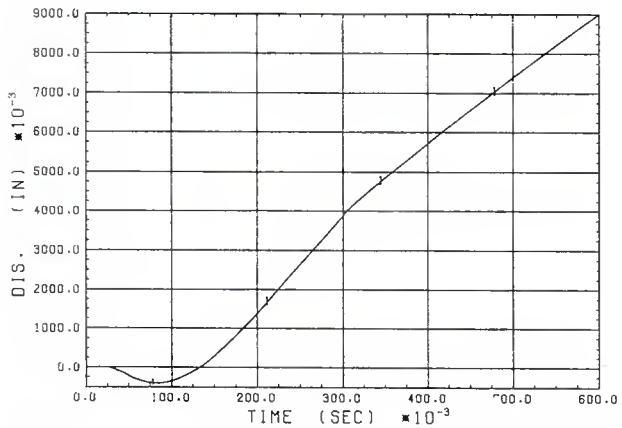

```
CURVE 1     PAGE 1
43FEAV01OR100R250    A L                250-10-AV-E       WES
5.9995E+03                        -7.0073E+03       2.2359E+03
0.0000E+00       5.9988E-01       -7.0073E+03       2.2359E+03
O-AV S-3 MIN ROCK-EAST
 TFILLP    0.0000E+00  4.0000E+00  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                    4962        2923        2923
```

(a) Raw file 2923 filtered, TFILLP, to 2500 Hz and decimated to 6000 samples/second




```
CURVE 1     PAGE 2
43FEAV01OR100R250    V LI               250-10-AV-E       WES
5.9995E+03                        -1.3446E+01       2.5853E+01
0.0000E+00       5.9988E-01       -1.3446E+01       2.5853E+01
O-AV S-3 MIN ROCK-EAST
 TFILLP    0.0000E+00  4.0000E+00  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                       0        2923        2923
 PINT      0.0000E+00
                                            0        2923        2923
```

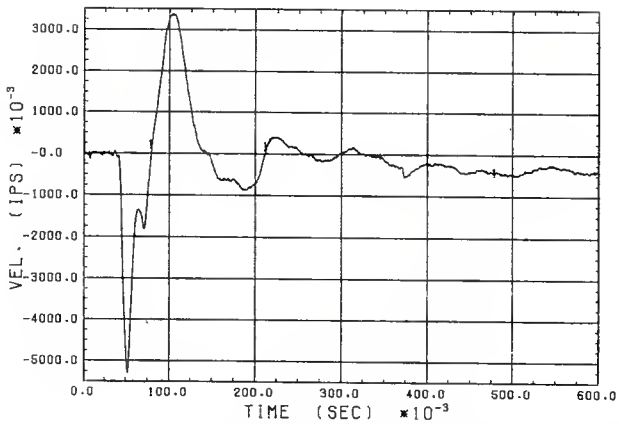
(b) Filtered file 2923 integrated, PINT, to obtain velocity




```
CURVE 1     PAGE 3
43FEAV01OR100R250    D LII              250-10-AV-E       WES
5.9995E+03                        -4.0490E-01       9.0046E+00
0.0000E+00       5.9988E-01       -4.0490E-01       9.0046E+00
O-AV S-3 MIN ROCK-EAST
 TFILLP    0.0000E+00  4.0000E+00  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                       0        2923        2923
 PINT      0.0000E+00
                                            0        2923        2923
 PINT      0.0000E+00
                                            0        2923        2923
```

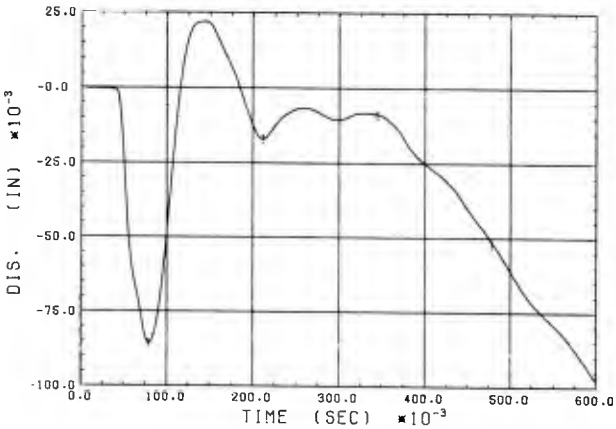
(c) Filtered file 2923 double integrated, PINT and PINT, to obtain displacement

FIGURE 2-31. SAMPLE OF RAW ACCELERATION MEASUREMENT AND RESPECTIVE INTEGRALS




```
CURVE 1     PAGE 13
43FEVV010A100R250    V L                    250-10-UV-E        WES
6.0002E+03                          -5.3019E+00       3.3920E+00
0.0000E+00       5.9981E-01         -5.3019E+00       3.3920E+00
0-UV 13-3 MIN ROCK-EAST
 TFILLP    0.0000E+00  2.0000E+00  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                    4966        3061        3061
```

(a) Raw file 3061 filtered, TFILLP, to 2500 Hz and decimated to 6000 samples/second

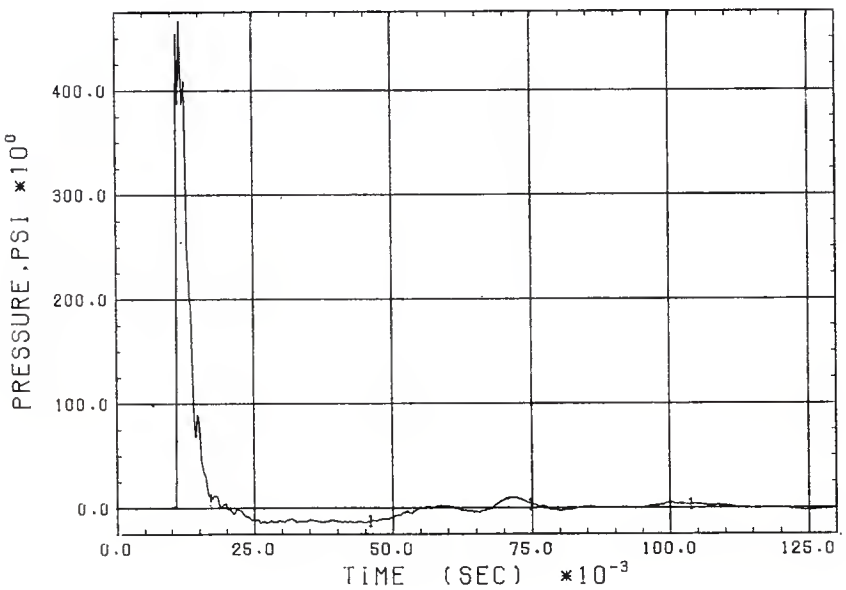



```
CURVE 1     PAGE 14
43FEVV010A100R250    D LI                   250-10-UV-E        WES
6.0002E+03                          -9.7916E-02       2.2015E-02
0.0000E+00       5.9981E-01         -9.7916E-02       2.2015E-02
0-UV 13-3 MIN ROCK-EAST
 TFILLP    0.0000E+00  2.0000E+00  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                       0        3061        3061
 PINT      0.0000E+00
                                             0        3061        3061
```

(b) Filtered file 3061 integrated, PINT, to obtain displacement

FIGURE 2-32. SAMPLE OF RAW VELOCITY MEASUREMENT AND RESPECTIVE INTEGRAL

PAGE 1



CURVE 1 PAGE 1
43BEPS000A150R120 P L BRL
5.0000E+03 -1.4730E+01 4.6669E+02
-1.0000E-05 1.3019E-01 -1.4730E+01 4.6669E+02
2-14.120.0
TFILLP 0.0000E+00 2.0000E+01 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 4970 4476 4476

FIGURE 2-33. SAMPLE OF RAW AIR-BLAST MEASUREMENT (FILE 4476) FILTERED, TFILLP, TO 2500 HZ AND DECIMATED TO 5000 SAMPLES/SECOND

Review of the data presented in Figures 2-31 through 2-33 and in Appendix C leads to the conclusions that the acceleration measurements contained a trend in the form of constant offset, whereas the velocity and airblast measurements contained relatively no trend in that portion of the record containing the signal. Therefore, each acceleration, as exemplified in Figure 2-34, was detrended (DETN) by fitting a line with no slope to the section of the record containing the signal, and subtracting the line from that section. For example, in Figure 2-34, the print associated with the DETN option indicates a line with no slope fitted to the entire segment from 0.025 to 0.190 sec, which was subsequently subtracted from the entire segment.

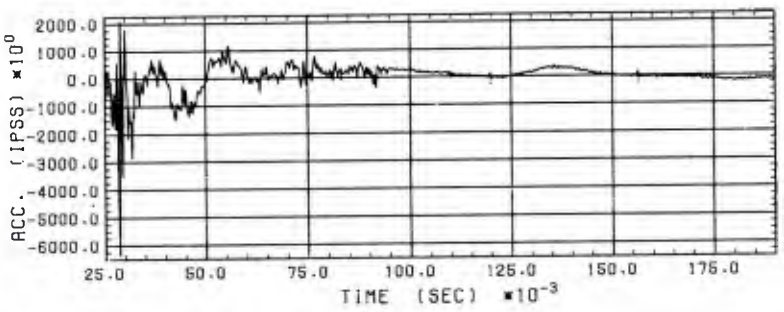
All the records were then integrated over the segment containing the signal, and the results for those data in Figures 2-31 through 2-33 are presented in Figures 2-34 through 2-36. Comparison of the integrations in Figures 2-31b and 2-31c with those in Figures 2-34b and 2-34c exemplify the effects of the detrend.

The Fourier transform amplitudes that were calculated from the data in Figures 2-34 through 2-36 are presented in Figures 2-37 through 2-39. The transform was calculated (FOUR) with a cosine taper applied to the end of the records. As before, the real and imaginary components produced by FOUR were converted to amplitude and phase via CPOL. Only the amplitudes are presented.

The shock spectra were computed for the motion measurements using the SHOXVE option, the results of which are presented in Figures 2-40 through 2-41. These figure sizes match the formats of standardized tripartite shock spectra grids. The shock spectra consist of values at 40 logarithmically equally spaced frequency intervals, computed for the forced phase of each record and with no damping.

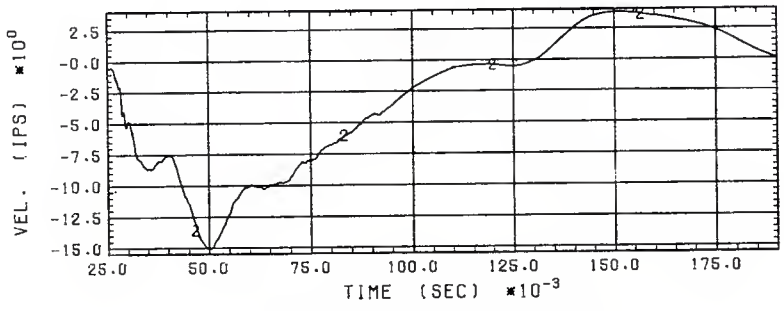
2.4.4 REQUESTOR'S COMMENTS

At the writing of this document, no comments concerning the processed data were received.



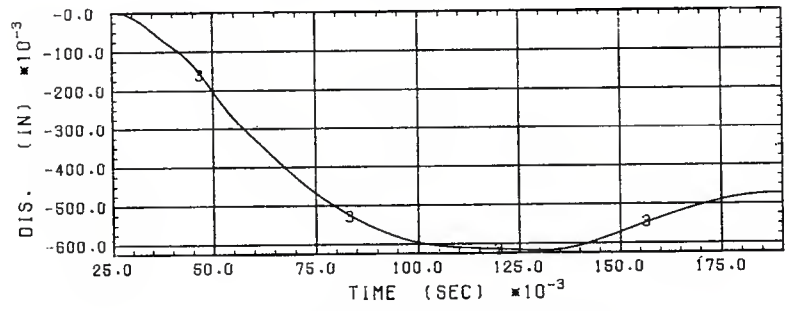
(a) Acceleration

```
CURVE 1     PAGE 1
43FEAV010A100R250    A LT              250-10-AV-E        WES
5.9995E+03                        -6.3496E+03       2.0921E+03
2.5002E-02      1.8985E-01        -6.3496E+03       2.0921E+03
0-AV 5-3 MIN ROCK-EAST
 TFILLP    0.0000E+00  4.0000E+00  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                    4974        4962        2923
 DETN      0.0000E+00  0.0000E+00  0.0000E+00
                                         4974        4962        2923
```



(b) Integration of (a)

```
CURVE 2     PAGE 1
43FEAV010A100R250    V LTI             250-10-AV-E        WES
5.9995E+03                        -1.5080E+01       3.7989E+00
2.5002E-02      1.8985E-01        -1.5080E+01       3.7989E+00
0-AV 5-3 MIN ROCK-EAST
 TFILLP    0.0000E+00  4.0000E+00  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                       0        4962        2923
 DETN      0.0000E+00  0.0000E+00  0.0000E+00
                                            0        4962        2923
 PINT      0.0000E+00
                                            0        4962        2923
```

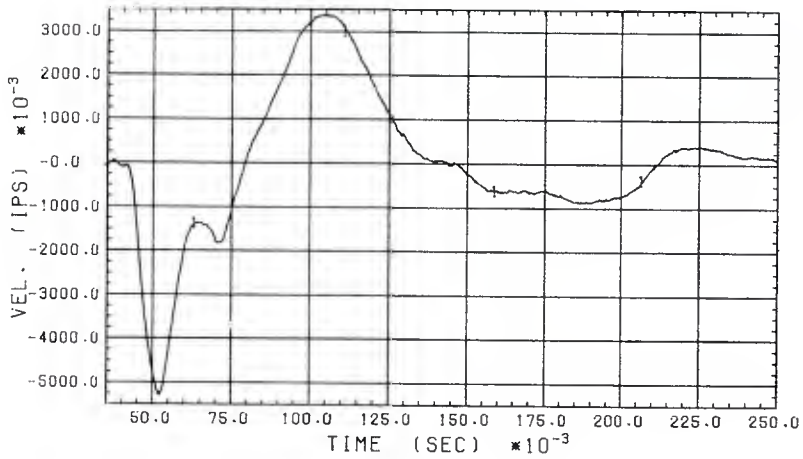


(c) Integration of (b)

```
CURVE 3     PAGE 1
43FEAV010A100R250    D LTII            250-10-AV-E        WES
5.9995E+03                        -6.1779E-01      -2.6074E-05
2.5002E-02      1.8985E-01        -6.1779E-01      -2.6074E-05
0-AV 5-3 MIN ROCK-EAST
 TFILLP    0.0000E+00  4.0000E+00  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                       0        4962        2923
 DETN      0.0000E+00  0.0000E+00  0.0000E+00
                                            0        4962        2923
 PINT      0.0000E+00
                                            0        4962        2923
 PINT      0.0000E+00
                                            0        4962        2923
```

NOTE: DETN, WITH AN OFFSET LEAST SQUARES FIT TO DATA FROM TIME BETWEEN 0.025 AND 0.190 SECONDS, INTEGRATED, PINT, TO OBTAIN VELOCITY, AND DOUBLE INTEGRATED, PINT AND PINT, TO OBTAIN DISPLACEMENT. PRESHOCK ARRIVAL NOISE HAS BEEN REMOVED.

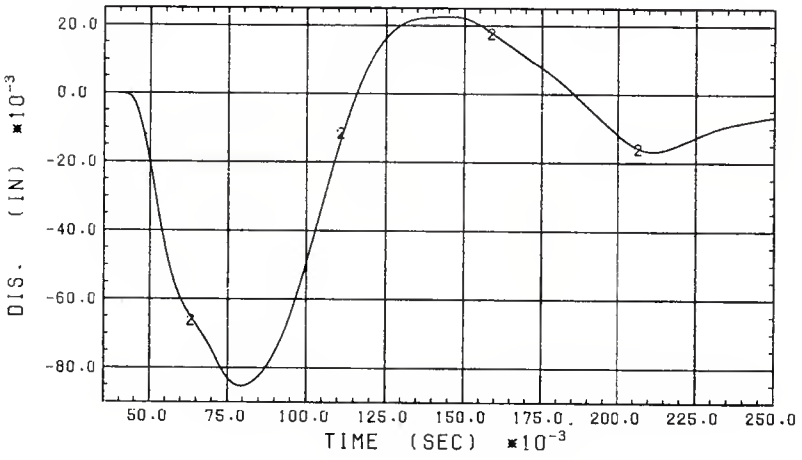
FIGURE 2-34. FILTERED FILE 2923 DETRENDED



CURVE 1 PAGE 9
43FEVV010A100R250 V L 250-10-UV-E WES
6.0002E+03 -5.3019E+00 3.3920E+00
3.5165E-02 2.4999E-01 -5.3019E+00 3.3920E+00
0-UV 13-3 MIN ROCK-EAST

TFILLP	0.0000E+00	2.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4966	3061

(a) Velocity

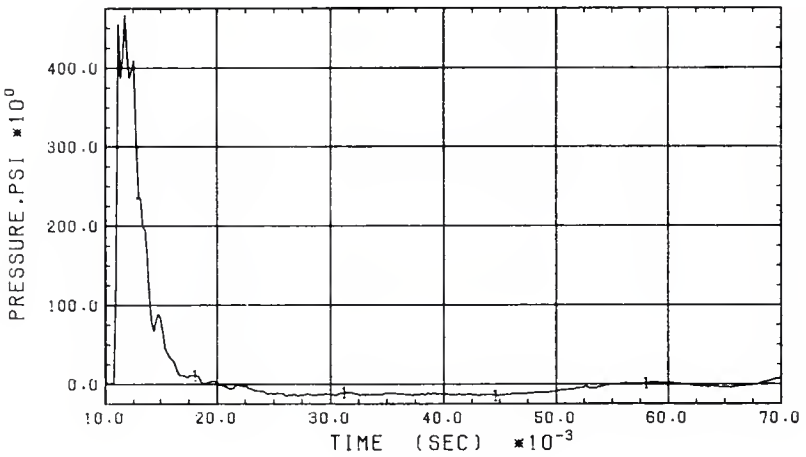


CURVE 2 PAGE 9
43FEVV010A100R250 D LI 250-10-UV-E WES
6.0002E+03 -8.5326E-02 2.2512E-02
3.5165E-02 2.4999E-01 -8.5326E-02 2.2512E-02
0-UV 13-3 MIN ROCK-EAST

TFILLP	0.0000E+00	2.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4966	3061
PINT	0.0000E+00				
			0	4966	3061

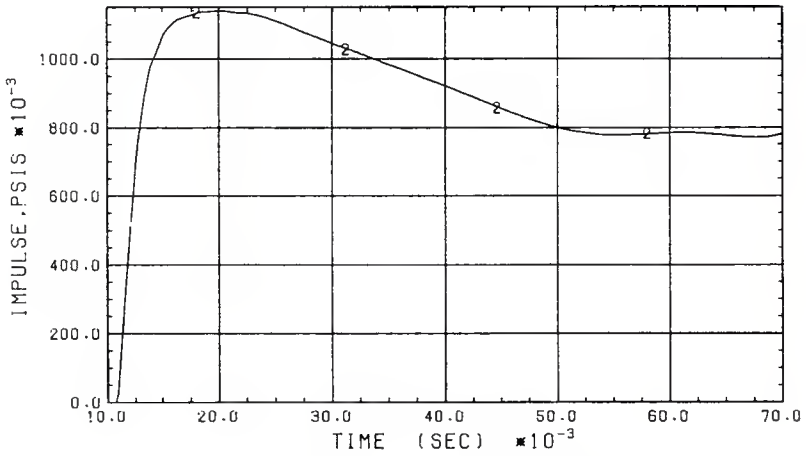
(b) Integration of (a)

FIGURE 2-35. FILTERED FILE 3061 WITH PRESHOCK ARRIVAL NOISE REMOVED AND INTEGRATED TO OBTAIN DISPLACEMENT



(a) Air blast

```
CURVE 1    PAGE 17
43BEPS000A150R120   P L                                          BRL
5.0000E+03                          -1.4730E+01      4.6669E+02
1.0190E-02      6.9990E-02          -1.4730E+01      4.6669E+02
 2-14.120.0
 TFILLP    0.0000E+00  2.0000E+01  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                        0        4970        4476
```

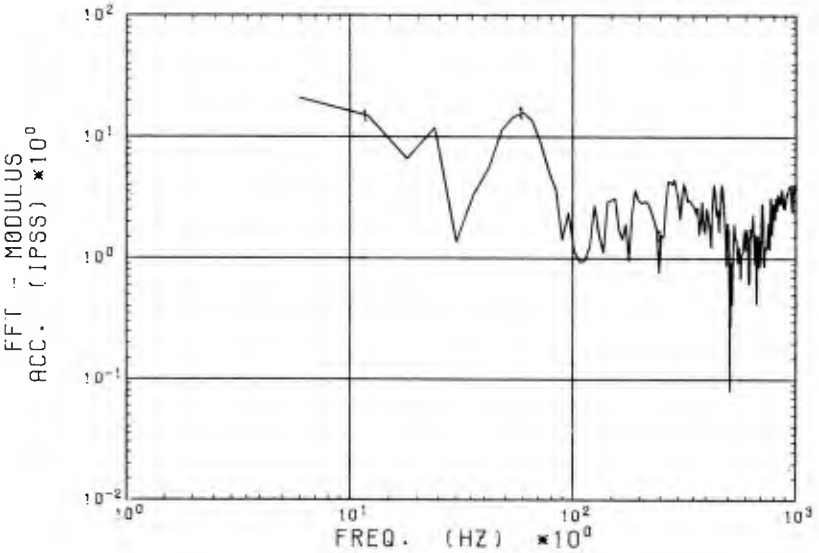


(b) Integration of (a)

```
CURVE 2    PAGE 17
43BEPS000A150R120   I LI                                         BRL
5.0000E+03                          2.5687E-04      1.1395E+00
1.0190E-02      6.9990E-02          2.5687E-04      1.1395E+00
 2-14.120.0
 TFILLP    0.0000E+00  2.0000E+01  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                        0        4970        4476
 PINT      0.0000E+00                        0        4970        4476
```

FIGURE 2-36. FILTERED FILE 4476 WITH PRESHOCK ARRIVAL NOISE REMOVED AND INTEGRATED TO OBTAIN IMPULSE

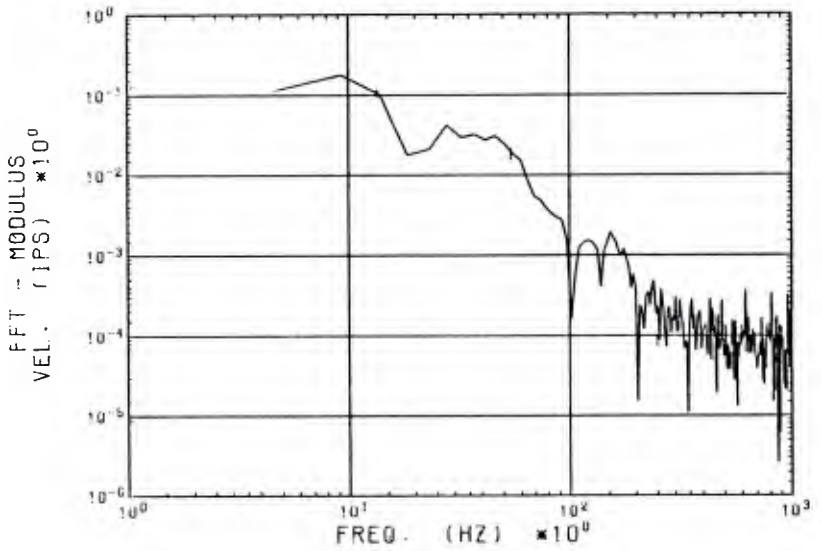
PAGE 2



CURVE 1 PAGE 2
43FEAV010A100R250 FA LTAF 250-10-AV-E WES
1.6668E-01 7.9766E-02 2.0730E+01
5.9995E+00 9.9592E+02 7.9766E-02 2.0730E+01
0-AV 5-3 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4962	2923
DETN	0.0000E+00	0.0000E+00	0.0000E+00		
			0	4962	2923
FOUR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4962	2923
CPOL	0.0000E+00				
			0	4962	2923

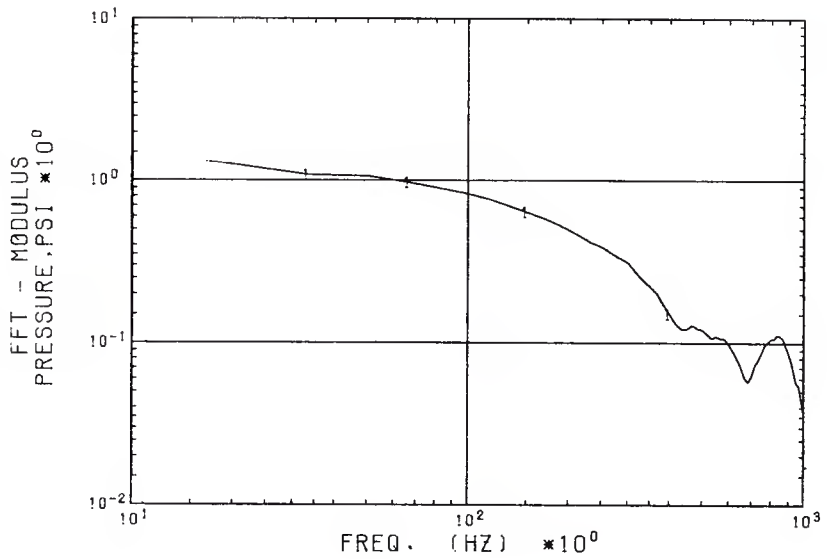
FIGURE 2-37. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP FILE 2923 WITH REAR 10% OF RECORD COSINE TAPERED



CURVE 1 PAGE 10
43FEVV01DA100R250 FV LAF 250-10-UV-E WES
2.1599E-01 2.6504E-06 1.7780E-01
4.6298E+00 9.9541E+02 2.6504E-06 1.7780E-01
0-UV 13-3 MIN ROCK-EAST

TFILLP	0.0000E+00	2.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4966	3061
FOUR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4966	3061
CPOL	0.0000E+00				
			0	4966	3061

FIGURE 2-38. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP VELOCITY RECORD WITH REAR 10% OF RECORD COSINE TAPERED



CURVE 1 PAGE 18
43BEPS000R150R120 FP LAF BRL
6.0000E-02 3.5899E-02 1.3220E+00
1.6667E+01 1.0000E+03 3.5899E-02 1.3220E+00
2-14.120.0

TFILLP	0.0000E+00	2.0000E+01	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4970	4476
F0UR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4970	4476
CP0L	0.0000E+00				
			0	4970	4476

FIGURE 2-39. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP FILE 4476 WITH REAR 10% OF RECORD COSINE TAPERED

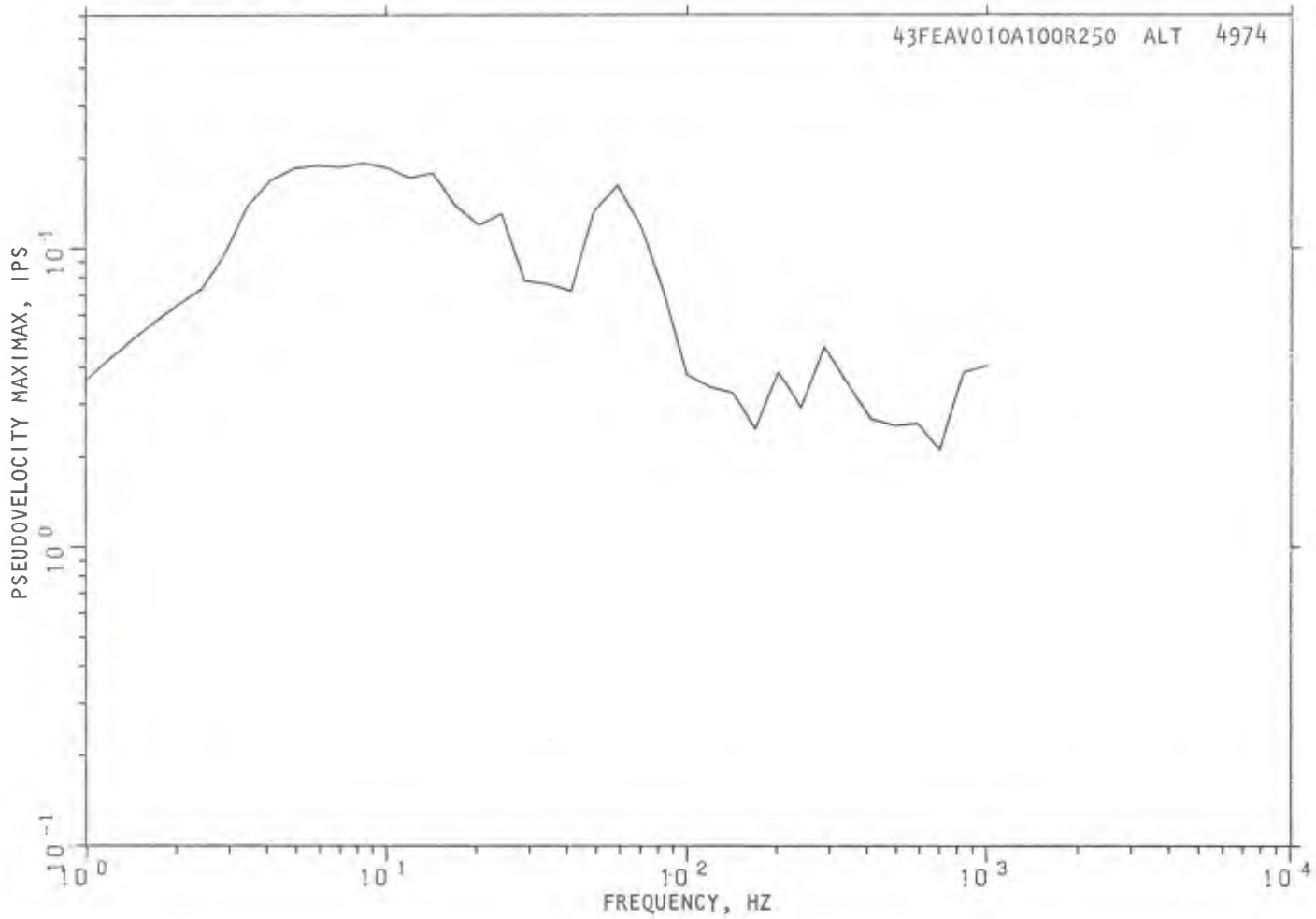


FIGURE 2-40. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP FILE 2923 WITH NO DAMPING AND NO RESIDUAL

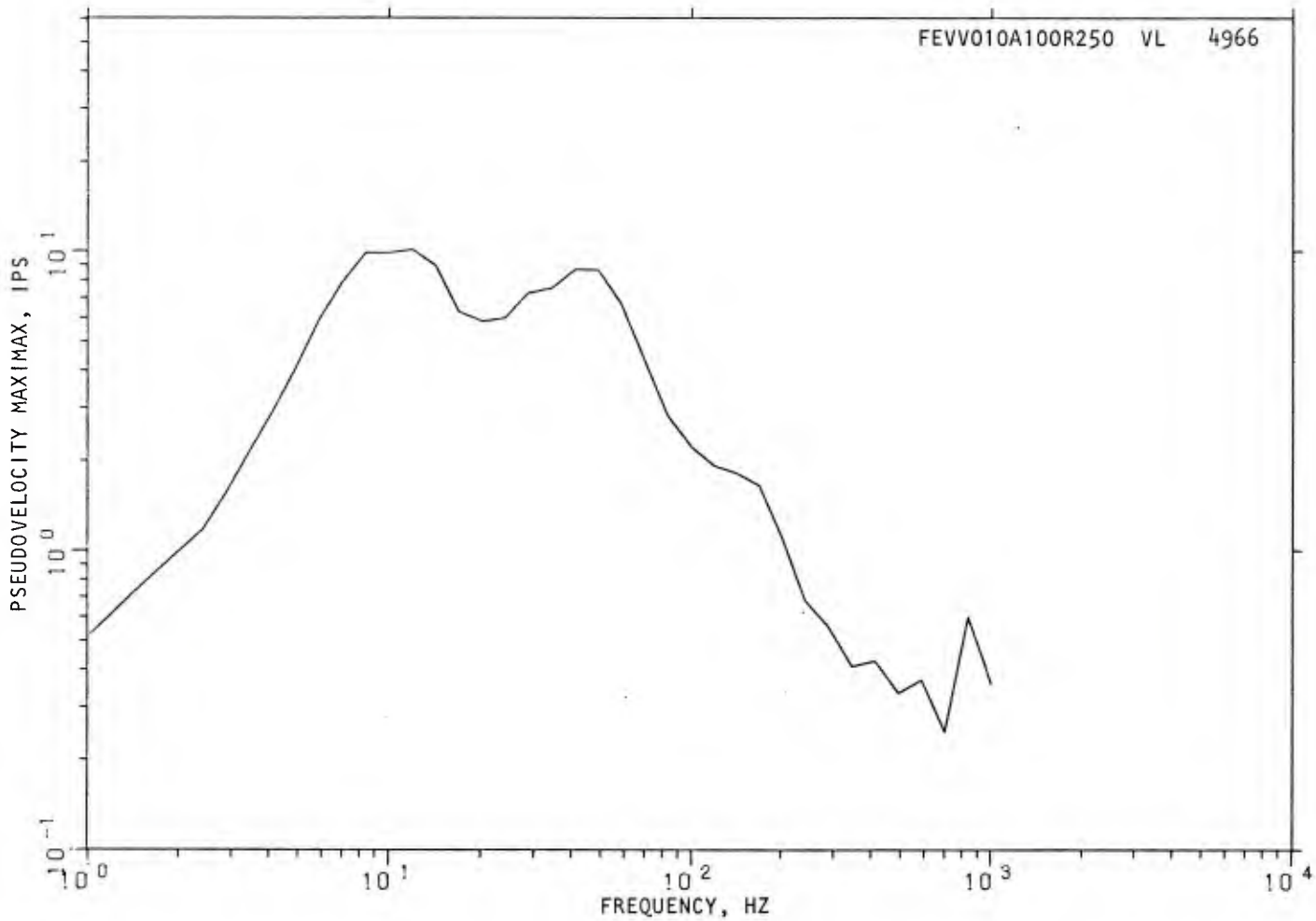


FIGURE 2-41. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP FILE 3061 WITH NO DAMPING AND NO RESIDUAL

2.4.5 CONCLUSIONS

The work discussed above is essentially the same as the work performed in response to the first Boeing Aerospace Company request.

SECTION 3

GUIDELINES FOR ESTIMATING LABOR AND COMPUTER COSTS

The test data acquired over decades has been accumulated in myriad forms and stored by many different organizations. Providing the data in usable and coherent form to the DNA technical community involves collecting, archiving, retrieving, and processing the data in consistent formats. While the cost of these operations is not trivial, the benefits realized by having such data readily available are persuasive in continuing such an activity. Therefore, the provision of dependable cost estimates for data retrieval and processing are prerequisites for planning any data processing activity.

In this section, guidelines for cost estimating based primarily on the archiving and processing described in Section 2 are examined.* The following specific areas are discussed:

a. Addition of edited data to the DNA Archive

b. Generation of a formatted data tape from the DNA Archive

c. Processing of DNA Archive data through a typical sequence of operations resulting in shock spectra

All computer time estimates are based on the work performed by the AA technical staff on a UNIVAC 1108, under the EXECUTIVE II operating system.

3.1 CONSIDERATION FOR USE OF GUIDELINES

The computer estimation guidelines presented in Section 3.2 are based on assumptions regarding the number of samples contained in a file and, in some cases, sampling characteristics. These assumptions, discussed in Section 3.2, should be studied before using the guidelines. Refer to Appendix D for development of generally applicable guidelines.

---

*More general guidelines to estimating costs for other types of archiving and processing are presented in Appendix D.

3.2 ESTIMATION GUIDELINES

The following is a presentation of computer and labor estimating guidelines for several archiving and processing areas.

3.2.1 ADDITION OF EDITED DATA

The following guideline is considered very reliable when estimating the computer time required to add a selected number of measurements, each of which contains from 35,000 to 55,000 samples, to the DNA Archive:

Computer Time, sec = 75 x number of data channels + 90

Generally, the labor required to perform this function can be estimated as follows:

Labor Hours = 0.2 x number of data channels + 7

Figure 3-1 graphically displays the estimating guidelines for addition of edited data to the DNA Archive. If the number of data samples exceeds the range specified above, it is recommended that the procedures discussed in Appendix D be implemented.

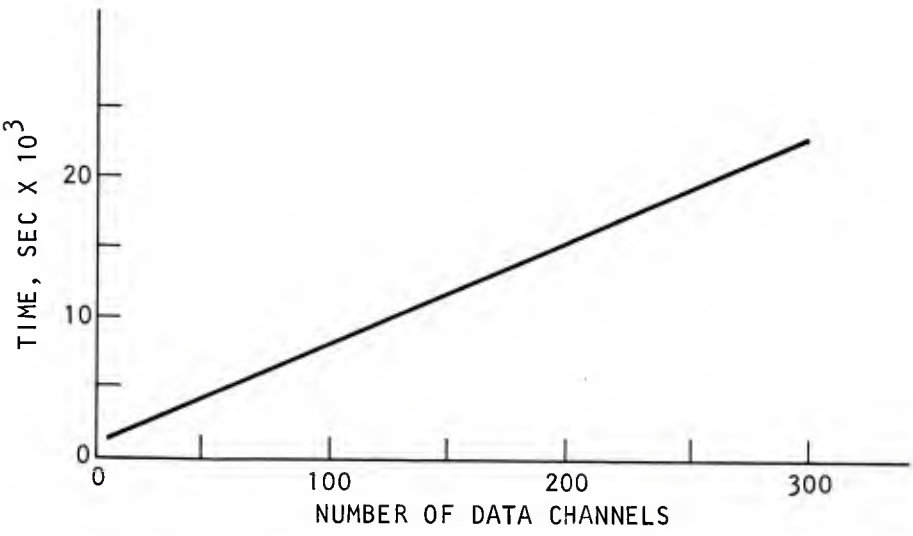
3.2.2 GENERATION OF FORMATTED DATA TAPE

The following guideline is considered very reliable when estimating the computer time required to generate a formatted data tape containing measurements of 5000 to 7000 data samples from the DNA Archive:

Computer Time, sec = 100 x number of data channels + 70

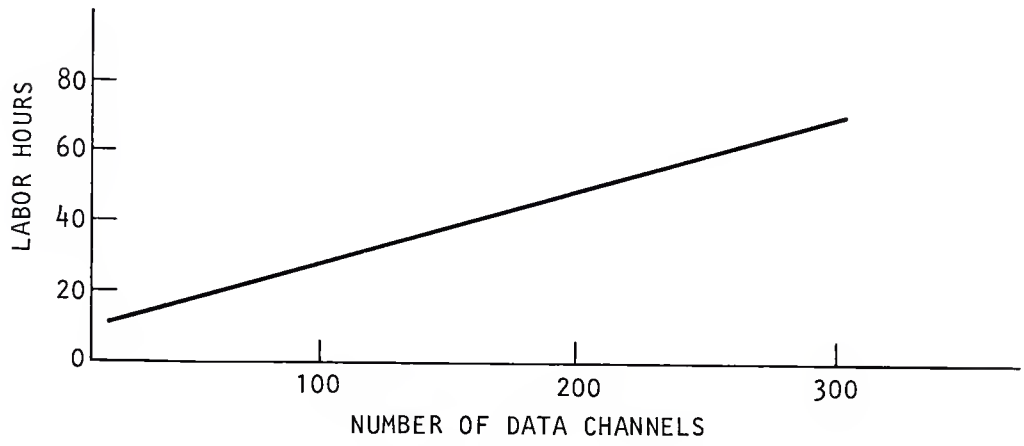
The labor required can be estimated as follows:

Labor Hours = 0.35 x number of data channels + 5



(a) Computer

NOTE: NUMBER OF SAMPLES FOR DATA CHANNELS RANGES FROM 35,000 TO 55,000



(b) Labor

FIGURE 3-1. ESTIMATING GUIDELINES FOR ADDITION OF EDITED DATA TO DNA ARCHIVES

Figure 3-2 graphically displays the estimation guidelines for generation of a formatted data tape.

3.2.3 SHOCK SPECTRA

The sequence of operations resulting in shock spectra consist of the following:

a. Filter
b. Detrend
c. Integrate
d. Shock Spectra
e. Plot

The guideline presented here is reliable when estimating the computer time to calculate shock spectra based on the following constraints:

a. Number of samples per measurement ranges from 40,000 to 50,000

b. The time period of interest is 10% of the measured period

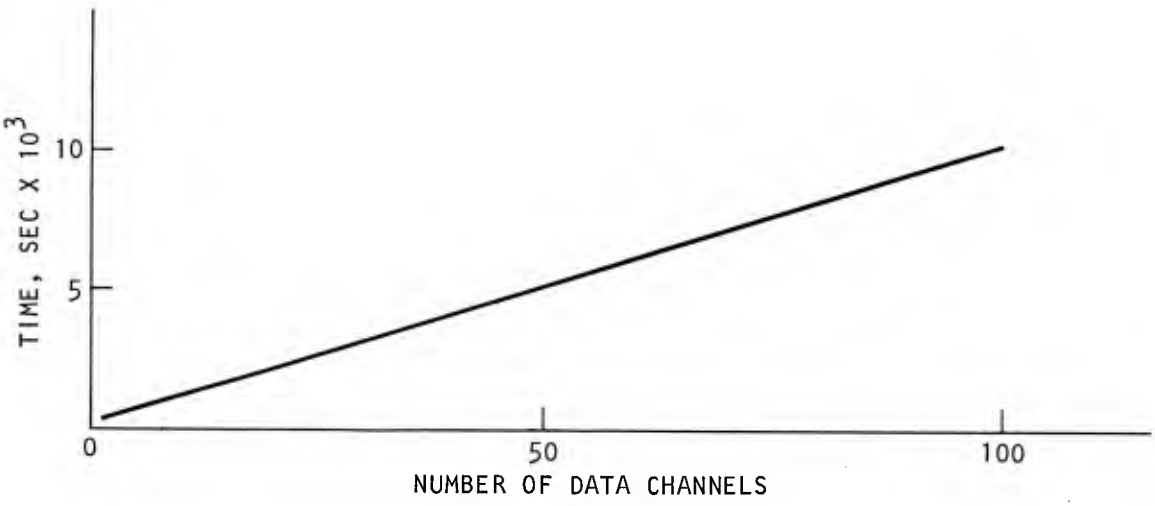
c. The highest frequency of interest is 10% of the sampling rate

The guidelines for estimating the computer time for processing of data through a typical sequence of operations resulting in shock spectra is as follows:

Computer Time, sec = 310 x number of data channels + 90

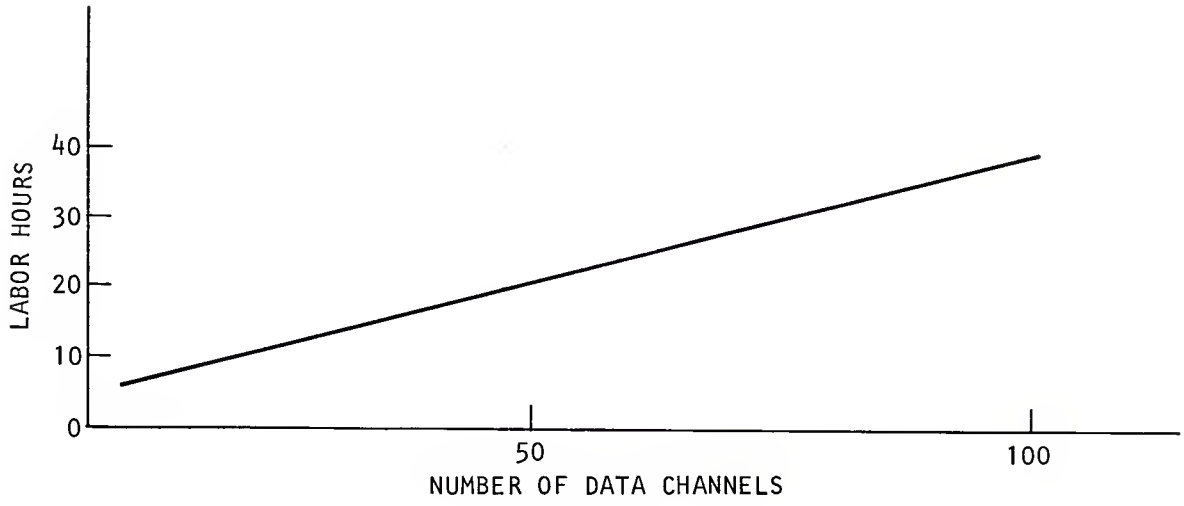
The amount of labor required in this area can be estimated as follows:

Labor Hours = 6.5 x number of data channels + 15



(a) Computer

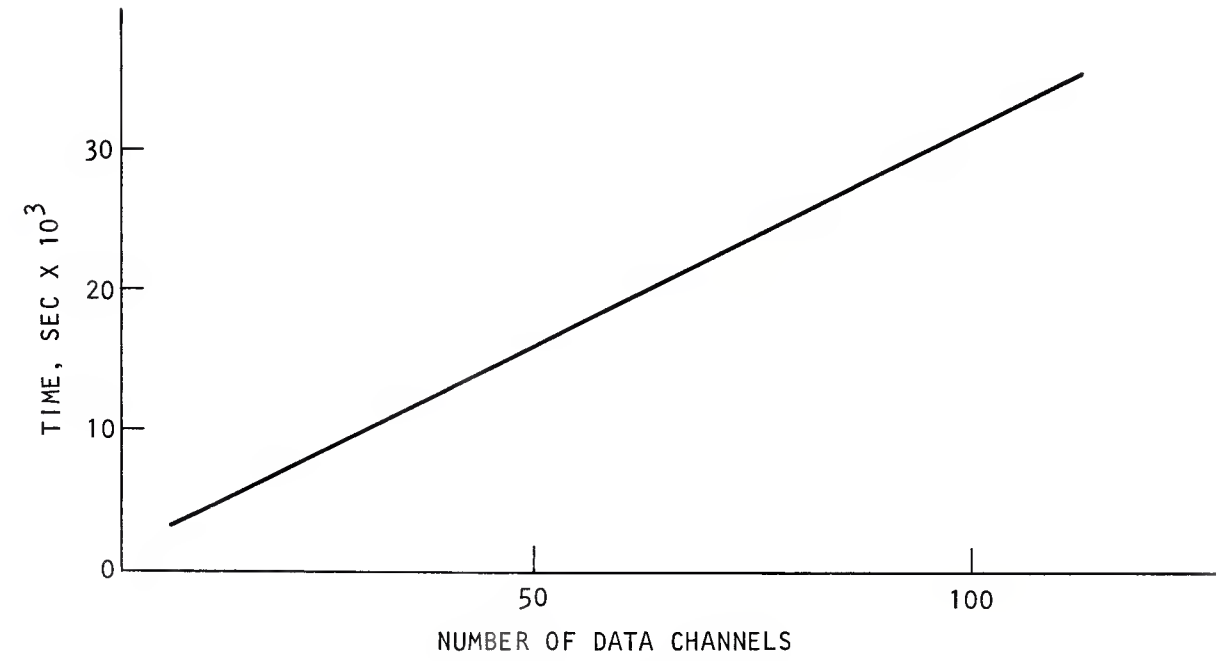
NOTE: NUMBER OF SAMPLES PER
DATA CHANNEL RANGES
FROM 5,000 TO 7,000



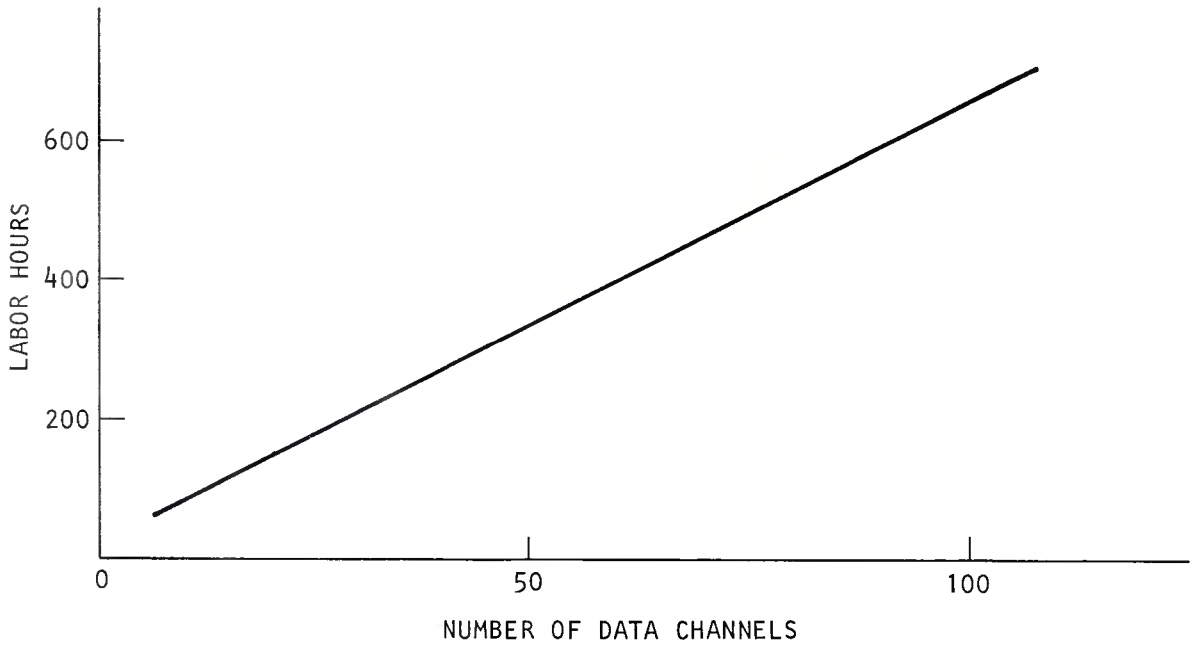
(b) Labor

FIGURE 3-2. ESTIMATING GUIDELINES FOR GENERATION OF FORMATTED DATA TAPE FROM THE DNA ARCHIVE

Figure 3-3 graphically displays the estimating guidelines for processing of DNA Archive data through a typical sequence of operations that will result in shock spectra.



(a) Computer



(b) Labor

FIGURE 3-3. ESTIMATING GUIDELINES FOR PROCESSING OF DNA ARCHIVE DATA THROUGH A TYPICAL SEQUENCE OF OPERATIONS RESULTING IN SHOCK SPECTRA

SECTION 4

REFERENCES

1. Agbabian Assoc. (AA). *DNA Master File of Ground-Shock, Air-Blast, and Structure-Response Data.* R-7530-1-3892. El Segundo, CA: AA, Nov 1975. (DNA3741F-1)

2. Agbabian Assoc. (AA). *Data Directory, DNA Data Archive, Vol. 1, Description and Use*, R-7530-3895. El Segundo, CA: AA, 1976.

3. Agbabian Assoc. (AA). *DATA/70S, Data Base Management and Processing System, Reference Manual,* R-3270-3515. El Segundo, CA: AA, Nov 1975.

4. Agbabian Assoc. (AA). *Data Directory, DNA Data Archive, Vol. 2, Appendixes A through D,* R-7530-3895. El Segundo, CA: AA, Mar 1976.

5. Agbabian Assoc. (AA). *Guidelines in Processing, Analysis, and Interpretation of Field Test Data,* R-7624-4-4309. El Segundo, CA: AA, Nov 1976.

6. DASIAC. *A Compilation of Test Information from a Series of DNA-Sponsored Nonnuclear Explosive Experiments,* SR-161. Santa Barbara, CA: GE TEMPO, Nov 1976.

7. Kelly, Ronald D. and Richman, G. *Principles and Techniques of Shock Data Analysis.* Washington, D.C.: Shock and Vibration Information Center, 1969.

8. Jaramillo, E.E. *Middle Gust Free-Field Data Analysis.* Air Force Weapons Laboratory, AFWL-TR-73-251, Apr 1974. (AD B002 242L)

APPENDIX A

List of Papers Presented at the DNA Data Archive Seminar in Los Angeles on 13 and 14 October 1976

APPENDIX A

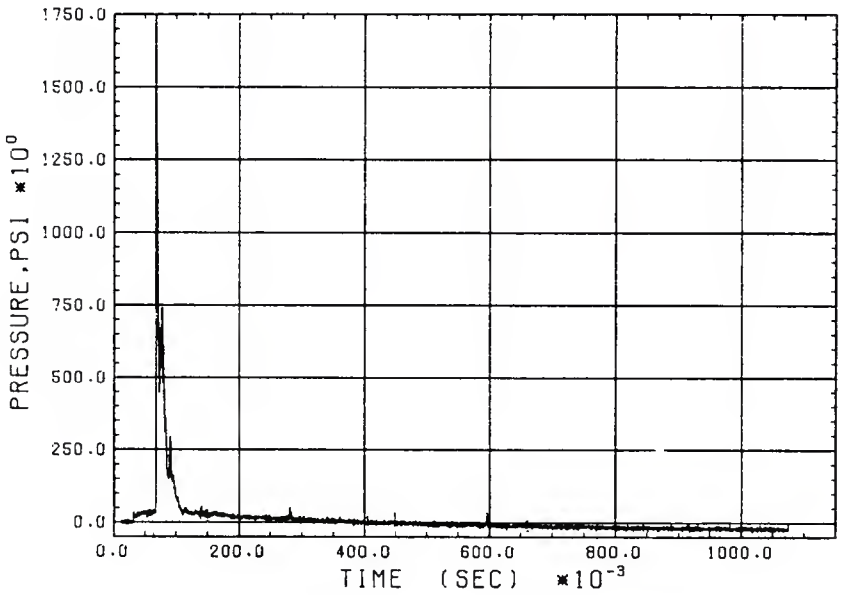
SEMINAR LECTURES, 13 AND 14 OCTOBER 1976

Title	Lecturer	Organization
Seismic Signatures of Nuclear Explosives as Compared to Earthquake Signatures	B.A. Bolt	University of California
Data Processing in Ground Motions and Structural Response	D.E. Hudson	California Institute of Technology
The Ground Shock Data Base and Its Deficiencies	H.F. Cooper, Jr.	R&D Associates
Site Characterization in Ground Motion Prediction	J.L. Bratton	Air Force Weapons Laboratory
Constitutive Models for Ground Shock Calculations: Lessons from Successes and Failures	P.F. Hadala	Waterways Experiment Station
Development of Generic Site Criteria from Data Archives	N. Lipner	TRW Systems Group
Dealing with Uncertainties in Design and Analysis	J.D. Collins	J.H. Wiggins Company
Special Problems Associated with Signal Processing of Mechanical Impedance	R.E. Walker	Waterways Experiment Station

APPENDIX B

Processed Data from the First Request from the Boeing Aerospace Company

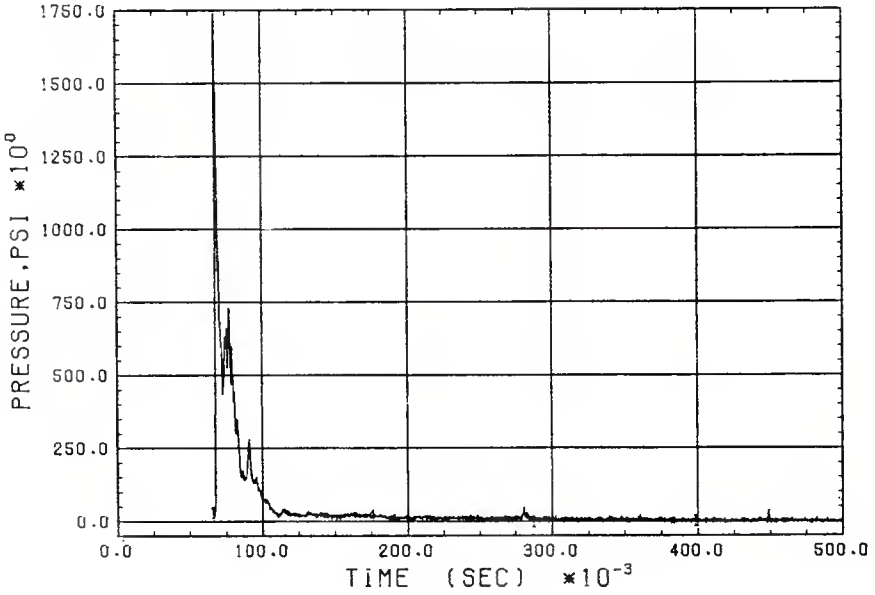
FILE 4325



CURVE 1 PAGE 3
068EPH-.SN6.0W3.7 I P L 342 RZ 18.32 AFWL
5.0000E+03 -3.2478E+01 1.7509E+03
0.0000E+00 1.1116E+00 -3.2478E+01 1.7509E+03
M-E-ABS3-(-0.5)-6.0-3.75-BP-H A175R300 FROM GZ
TFILLP 0.0000E+00 1.0000E+01 2.0000E+03 0.0000E+00 0.0000E+00
0.0000E+00 4948 4325 4325

FIGURE B-1. RAW AIR-BLAST RECORD FILTERED, TFILLP, TO 2000 HZ AND DECIMATED TO 5000 SAMPLES/SECOND

PAGE 16

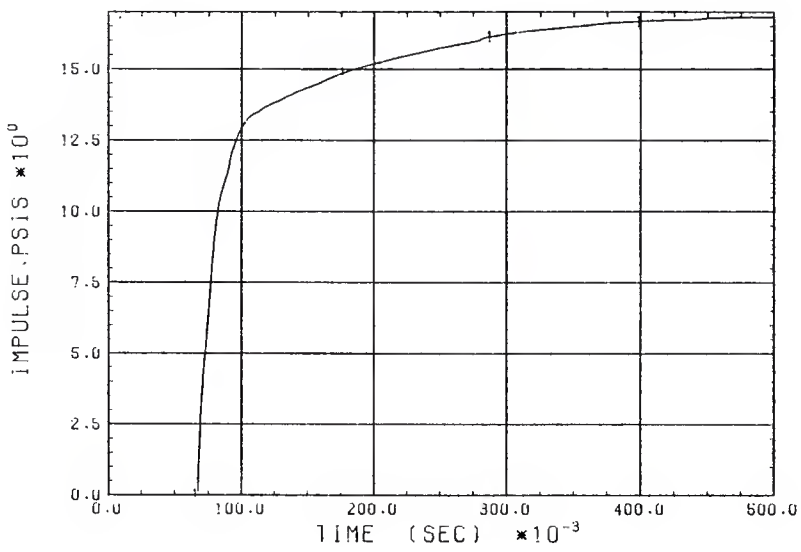


CURVE 1 PAGE 16
06BEPH-.5N6.0W3.7 I P LTS 342 RZ 18.32 AFWL
5.0000E+03 -1.2194E+01 1.7403E+03
0.0000E+00 5.0000E-01 -1.2194E+01 1.7403E+03
M-E-ABS3-(-0.5)-6.0-3.75-BP-H A175R300 FROM GZ

TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		4959	4948	4325
DETN	1.0000E+00	4.0000E-01	3.0000E+03		
			4959	4948	4325
PSTC	0.0000E+00	0.0000E+00	6.6000E-02		
			4959	4948	4325

NOTE: DETN, WITH A LINEAR LEAST SQUARES FIT TO DATA FROM TIME BETWEEN 0.4 AND 1.0 SECONDS AND LINE EXTENDED BACK INTO AND REMOVED FROM TIME 0 TO 0.5 SECONDS. PRESHOCK ARRIVAL NOISE HAS BEEN REMOVED FROM RECORD, PSTC

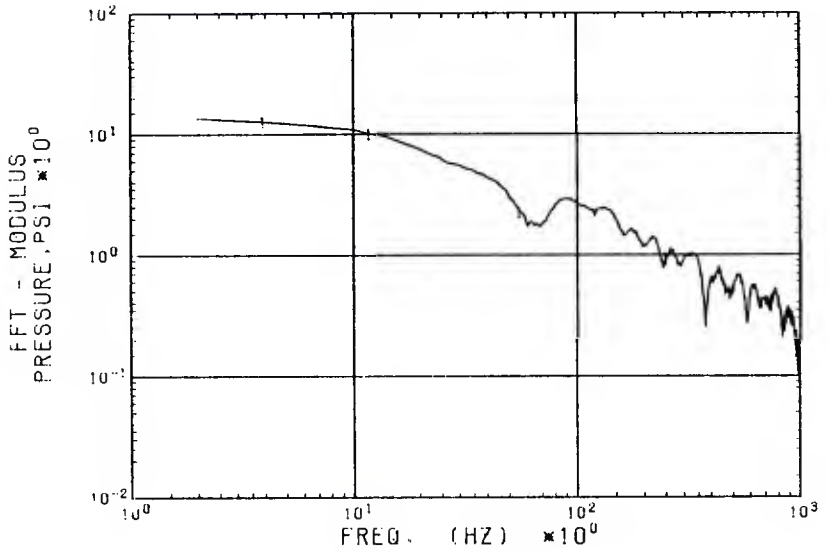
FIGURE B-2. FILTERED AIR-BLAST RECORD DETRENDED



CURVE 1 PAGE 17
OGBEPH--.5N6.0W3.7 I 1 LTSI 342 RZ 18.32 AFWL
5.0000E+03 0.0000E+00 1.6826E+01
0.0000E+00 5.0000E-01 0.0000E+00 1.6826E+01
M-E-ABS3-(-0.5)-6.0-3.75-BP-H A175R300 FROM GZ

TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4948	4325
DETN	1.0000E+00	4.0000E-01	3.0000E+03		
			0	4948	4325
PSTC	0.0000E+00	0.0000E+00	6.6000E-02		
			0	4948	4325
PINT	0.0000E+00				
			0	4948	4325

FIGURE B-3. CLEANED-UP AIR-BLAST RECORD INTEGRATED, PINT, TO OBTAIN IMPULSE

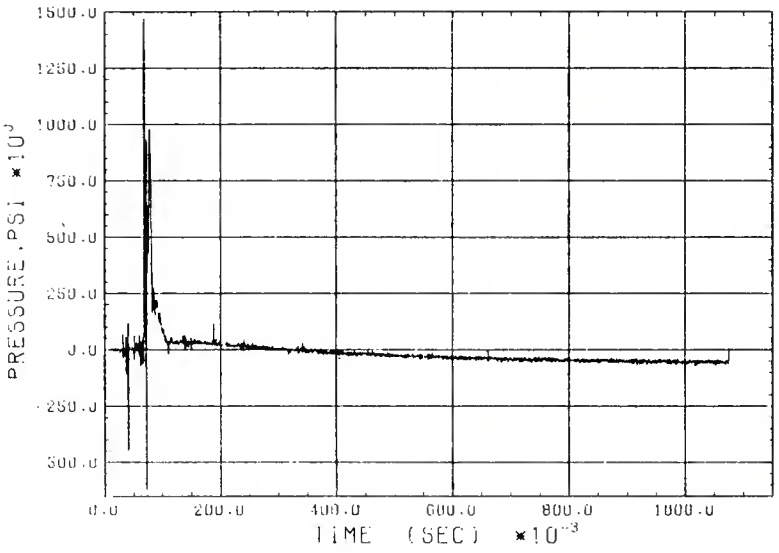


CURVE 1 PAGE 18
06BEPH-.5N6.0W3.7 IFP LTSAF 342 RZ 18.32 AFWL
5.0000E-01 7.3115E-02 1.3545E+01
2.0000E+00 1.0000E+03 7.3115E-02 1.3545E+01
M-E-ABS3-(-0.5)-6.0-3.75-BP--H A175R300 FROM GZ

TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4948	4325
DETN	1.0000E+00	4.0000E-01	3.0000E+03		
			0	4948	4325
PSTC	0.0000E+00	0.0000E+00	6.6000E-02		
			0	4948	4325
FOUR	2.5000E+03	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4948	4325
CPOL	0.0000E+00				
			0	4948	4325

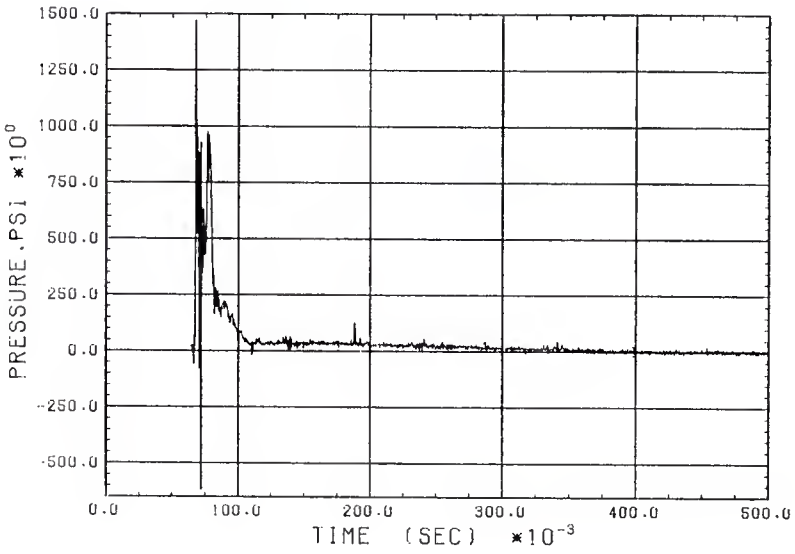
FIGURE B-4. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP AIR-BLAST RECORD WITH REAR 10% OF RECORD COSINE TAPERED

FILE 4326




```
CURVE 1    PAGE 4
06BEPH-3.N6.0W3.7 I P L                    343 RZ 18.32      AFWL
5.0000E+03                      -6.1928E+02      1.4724E+03
0.0000E+00      1.1116E+00      -6.1928E+02      1.4724E+03
 M-E-ABS3-(-3.0)-6.0-3.75-BP-H A17SR300 FROM GZ
 TFILLP   0.0000E+00  1.0000E+01  2.0000E+03  0.0000E+00  0.0000E+00
          0.0000E+00                  4949        4326        4326
```

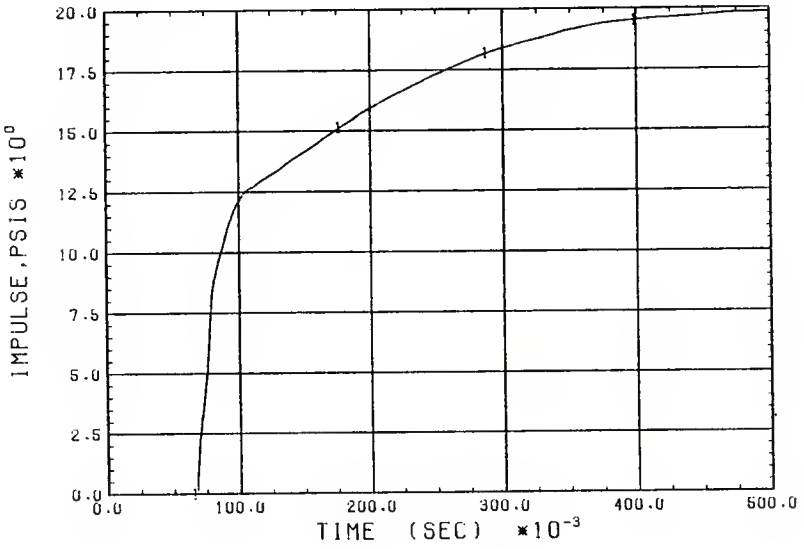
FIGURE B-5. RAW AIR-BLAST RECORD FILTERED, TFILLP, TO 2000 HZ AND DECIMATED TO 5000 SAMPLES/SEC



CURVE 1 PAGE 19
O6BEPH-3.N6.OW3.7 I P LTS 343 RZ 18.32 AFWL
5.0000E+03 -6.2079E+02 1.4707E+03
0.0000E+00 5.0000E-01 -6.2079E+02 1.4707E+03
M-E-ABS3-(-3.0)-6.0-3.75-BP-H A175R300 FROM GZ

IFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		4960	4949	4326
DETN	1.0000E+00	4.0000E-01	3.0000E+03		
			4960	4949	4326
PSTC	0.0000E+00	0.0000E+00	6.6000E-02		
			4960	4949	4326

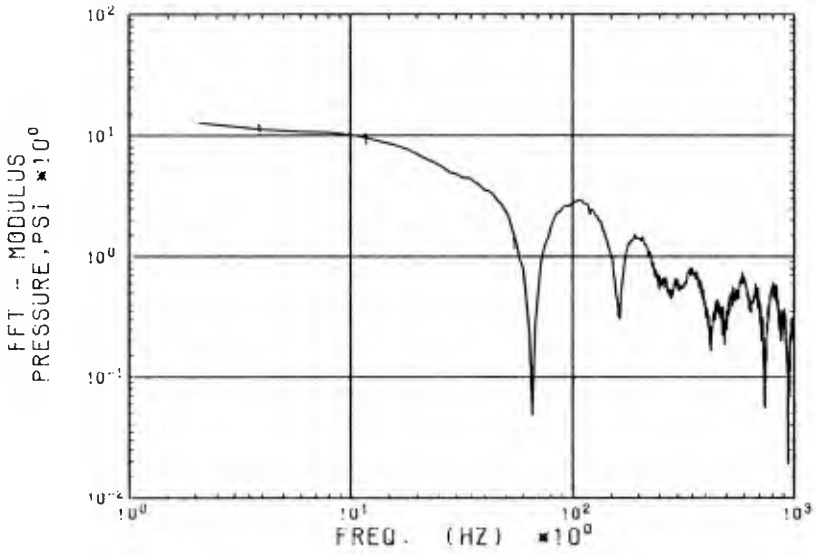
FIGURE B-6. FILTERED AIR-BLAST RECORD DETRENDED, DETN, WITH A LINEAR LEAST SQUARES FIT TO DATA FROM TIME BETWEEN 0.4 AND 1.0 SECONDS AND LINE EXTENDED BACK INTO AND REMOVED FROM DATA FROM TIME 0 TO 0.5 SECONDS. PRESHOCK ARRIVAL NOISE HAS BEEN REMOVED FROM RECORD, PSTC.



CURVE 1 PAGE 20
06BEPH-3.N6.0W3.7 1 1 LTS1 343 RZ 18.32 AFWL
5.0000E+03 -8.6947E-03 1.9836E+01
0.0000E+00 5.0000E-01 -8.6947E-03 1.9836E+01
M-E-ABS3-(-3.0)-6.0-3.75-BP-H A175R300 FROM GZ

TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4949	4326
OETN	1.0000E+00	4.0000E-01	3.0000E+03		
			0	4949	4326
PSTC	0.0000E+00	0.0000E+00	6.6000E-02		
			0	4949	4326
PINT	0.0000E+00				
			0	4949	4326

FIGURE B-7. CLEANED-UP AIR-BLAST RECORD INTEGRATED, PINT, TO OBTAIN IMPULSE

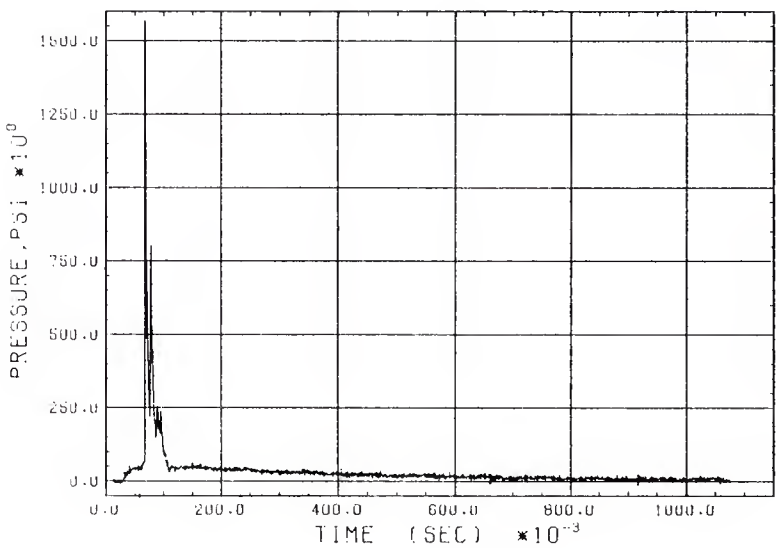


CURVE 1 PAGE 21
06BEPH-3.N6.0W3.7 IFP LTSAF 343 RZ 18.32 AFWL
5.0000E-01 1.9068E-02 1.2780E+01
2.0000E+00 1.0000E+03 1.9068E-02 1.2780E+01
M-E-ABS3-(-3.0)-6.0-3.75-BP-H A175R300 FROM GZ

TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4949	4326
DETN	1.0000E+00	4.0000E-01	3.0000E+03		
			0	4949	4326
PSTC	0.0000E+00	0.0000E+00	6.6000E-02		
			0	4949	4326
FOUR	2.5000E+03	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4949	4326
CPOL	0.0000E+00				
			0	4949	4326

FIGURE B-8. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP AIR-BLAST RECORD WITH REAR 10% OF RECORD COSINE TAPERED

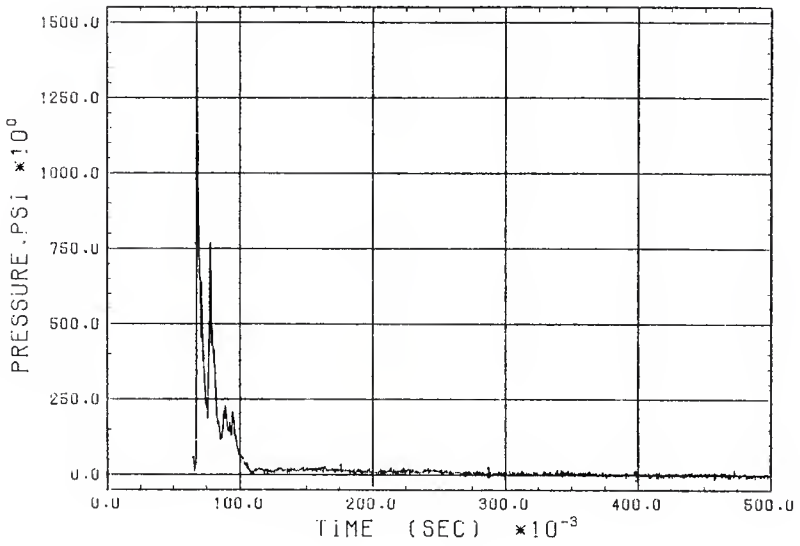
FILE 4725



CURVE 1 PAGE 1
06BEPH-5.N6.0W3.7 I P L 344 RZ 18.32 AFWL
5.0000E+03 -1.0570E+01 1.5687E+03
0.0000E+00 1.1116E+00 -1.0570E+01 1.5687E+03
M-E-ABS3--(-5.5)-6.0-3.75-BP-H A175R300 FROM GZ

TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		4946	4725	4725

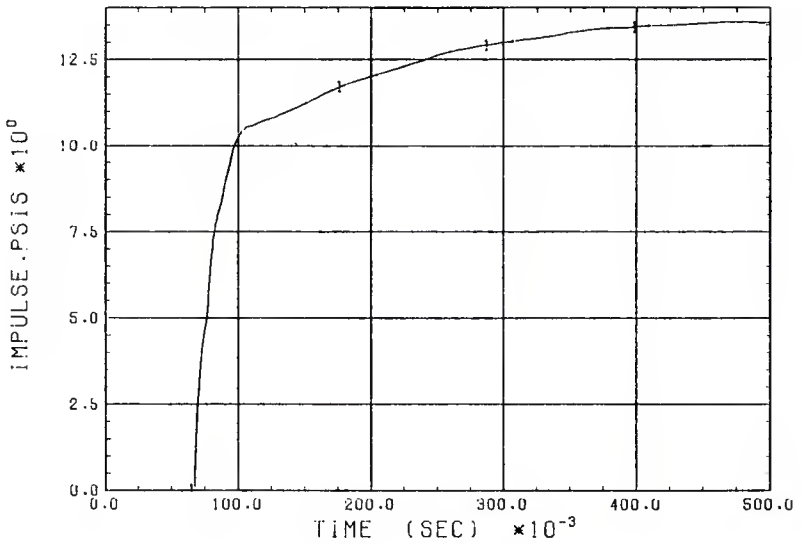
FIGURE B-9. RAW AIR-BLAST RECORD FILTERED, TFILLP, TO 2000 HZ AND DECIMATED TO 5000 SAMPLES/SEC



CURVE 1 PAGE 13
06BEPH--5.N6.0W3.7 I P LTS 344 RZ 18.32 AFWL
5.0000E+03 --1.3908E+01 1.5369E+03
0.0000E+00 5.0000E-01 --1.3908E+01 1.5369E+03
M-E-ABS3-(-5.5)-6.0-3.75-BP-H A175R300 FROM GZ

TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00	
	0.0000E+00		4958	4946	4725	
DETN	1.0000E+00	4.0000E-01	3.0000E+03			
			4958	4946	4725	
PSTC	0.0000E+00	0.0000E+00	6.6000E-02			
			4958	4946	4725	

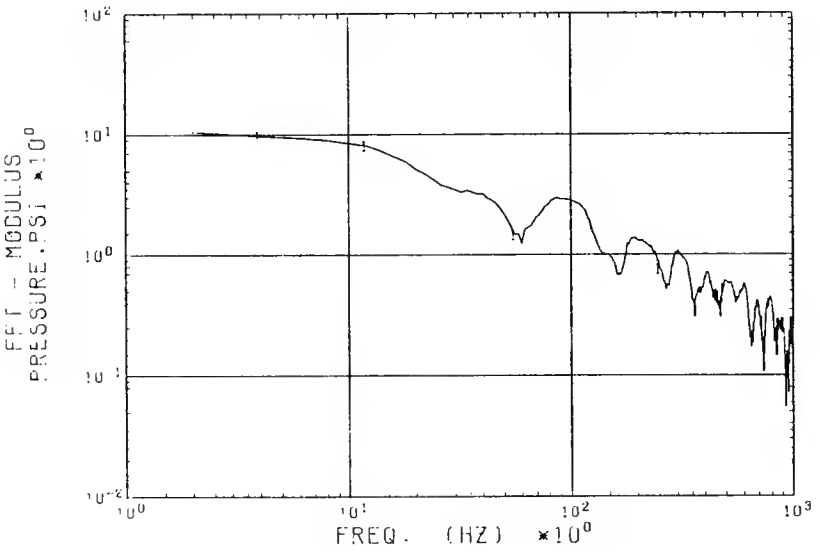
FIGURE B-10. FILTERED AIR-BLAST RECORD DETRENDED, DETN, WITH A LINEAR LEAST SQUARES FIT TO DATA FROM TIME BETWEEN 0.4 AND 1.0 SECONDS AND LINE EXTENDED BACK INTO AND REMOVED FROM DATA FROM TIME 0 TO 0.5 SECONDS. PRESHOCK ARRIVAL NOISE HAS BEEN REMOVED FROM RECORD, PSTC



CURVE 1 PAGE 14
06BEPH-5.N6.0W3.7 1 I LTSI 344 RZ 18.32 AFWL
5.0000E+03 0.0000E+00 1.3601E+01
0.0000E+00 5.0000E-01 0.0000E+00 1.3601E+01
M-E-ABS3--(-5.5)-6.0-3.75-BP-H A175R300 FROM GZ

TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4946	4725
DETN	1.0000E+00	4.0000E-01	3.0000E+03		
			0	4946	4725
PSTC	0.0000E+00	0.0000E+00	6.6000E-02		
			0	4946	4725
PINT	0.0000E+00				
			0	4946	4725

FIGURE B-11. CLEANED-UP AIR-BLAST RECORD INTEGRATED, PINT, TO OBTAIN IMPULSE

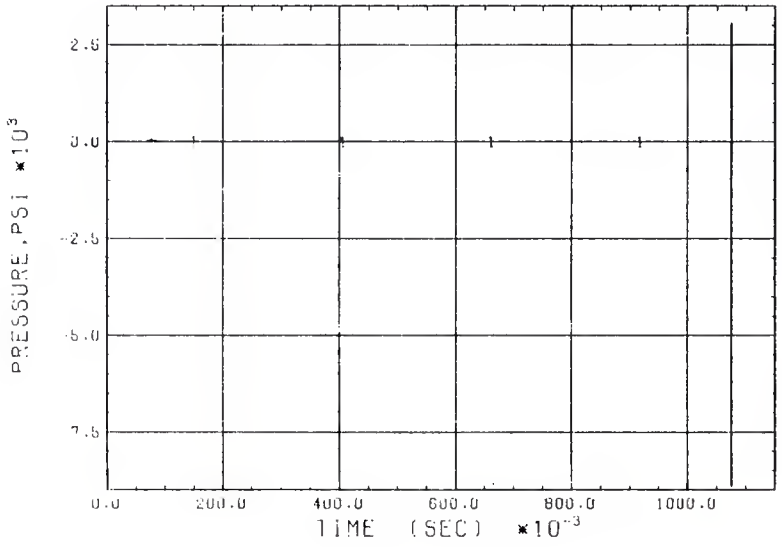


CURVE 1 PAGE 15
OGREPH-5.N6.0W3.7 IFP LTSAF 344 RZ 18.32 AFWL
5.0000E-01 5.5300E-02 1.0552E+01
2.0000E+00 1.0000E+03 5.5300E-02 1.0552E+01
M-E-ABS3--(-5.5)-6.0-3.75-BP-H A175R300 FROM GZ

TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4946	4725
DETN	1.0000E+00	4.0000E-01	3.0000E+03		
			0	4946	4725
PSTC	0.0000E+00	0.0000E+00	6.0000E-02		
			0	4946	4725
FOUR	2.5000E+03	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4946	4725
CPOL	0.0000E+00				
			0	4946	4725

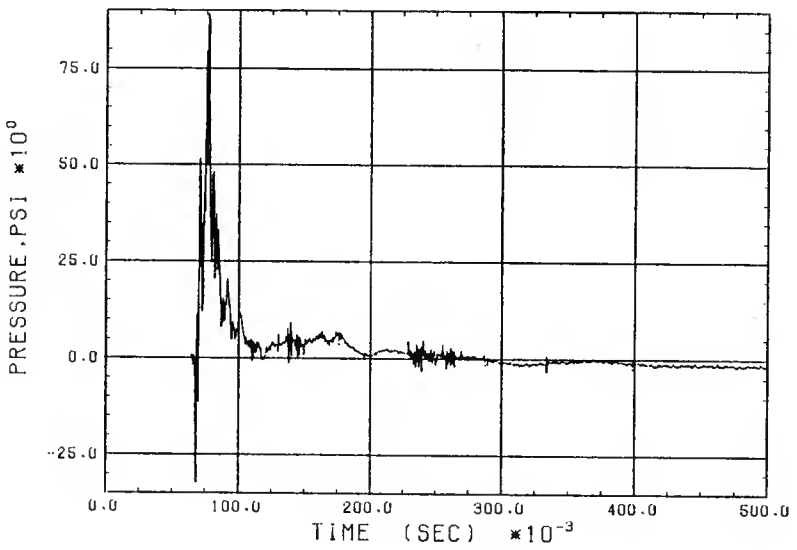
FIGURE B-12. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP AIR-BLAST RECORD WITH REAR 10% OF RECORD COSINE TAPERED

FILE 4728



CURVE 1 PAGE 2
06BEPN-.5N11.W8.1 I P L 353 RZ 18.32 AFWL
5.0000E+03 -8.9051E+03 3.0685E+03
0.0000E+00 1.1116E+00 -8.9051E+03 3.0685E+03
M-E-AB53-(-0.5)-11.5-8.1-BP-N A175R300 FROM GZ
TFILLP 0.0000E+00 1.0000E+01 2.0000E+03 0.0000E+00 0.0000E+00
0.0000E+00 4947 4728 4728

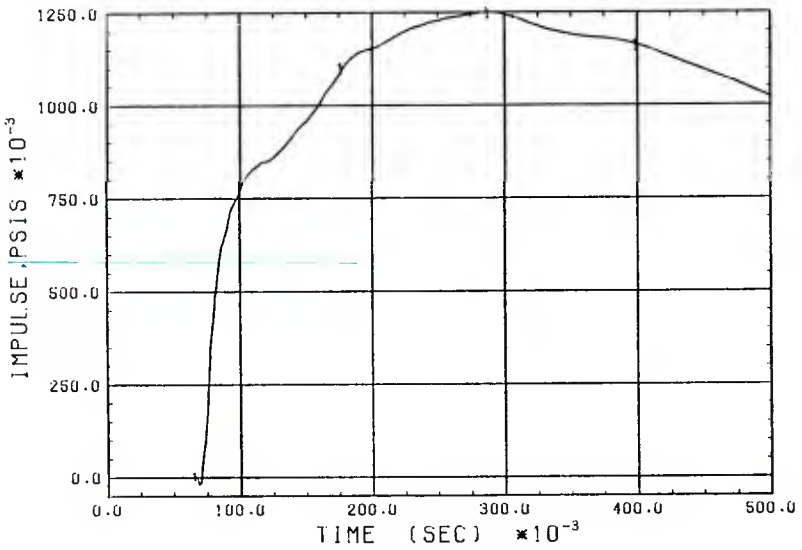
FIGURE B-13. RAW AIR-BLAST RECORD FILTERED, TFILLP, TO 2000 HZ AND DECIMATED TO 5000 SAMPLES/SEC



CURVE 1 PAGE 22
06BEPN-.5N11.W8.1 I P LS 353 RZ 18.32 AFWL
5.0000E+03 -3.2337E+01 8.9204E+01
0.0000E+00 5.0000E-01 -3.2337E+01 8.9204E+01
M-E-ABS3-(-0.5)-11.5-8.1-BP-N A175R300 FROM GZ

TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		4961	4947	4728
PSTC	0.0000E+00	0.0000E+00	6.6000E-02		
			4961	4947	4728

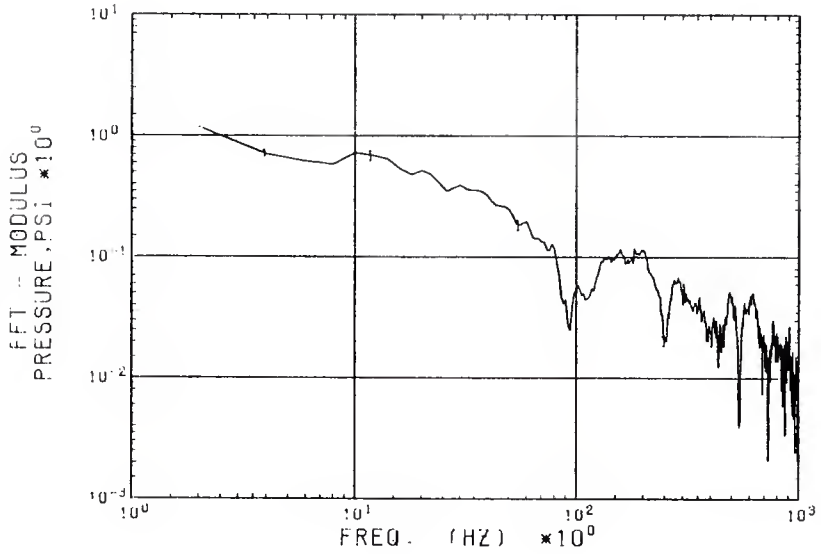
FIGURE B-14. FILTERED AIR-BLAST RECORD WITH PRESHOCK ARRIVAL NOISE REMOVED, PSTC



CURVE 1 PAGE 23
O6BEPN-.5N11.W8.1 I I LSI 353 RZ 18.32 AFWL
5.0000E+03 -1.9889E-02 1.2505E+00
0.0000E+00 5.0000E-01 -1.9889E-02 1.2505E+00
M-E-ABS3-(-0.5)-11.5-8.1-BP-N A175R300 FROM GZ

TFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4947	4728
PSTC	0.0000E+00	0.0000E+00	6.6000E-02		
			0	4947	4728
PINT	0.0000E+00				
			0	4947	4728

FIGURE B-15. CLEANED-UP AIR-BLAST RECORD INTEGRATED, PINT, TO OBTAIN IMPULSE



CURVE 1 PAGE 24
06BEPN-.5N11.W8.1 IFP LSAF 353 RZ 18.32 AFWL
5.0000E-01 2.0781E-03 1.1745E+00
2.0000E+00 1.0000E+03 2.0781E-03 1.1745E+00
M-E-ABS3-(-0.5)-11.5-8.1-BP-N A175R300 FROM GZ

IFILLP	0.0000E+00	1.0000E+01	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4947	4728
PSTC	0.0000E+00	0.0000E+00	6.6000E-02		
			0	4947	4728
FOUR	2.5000E+03	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4947	4728
CPOL	0.0000E+00				
			0	4947	4728

FIGURE B-16. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP AIR-BLAST RECORD WITH REAR 10% OF RECORD COSINE TAPERED

FILE 2486

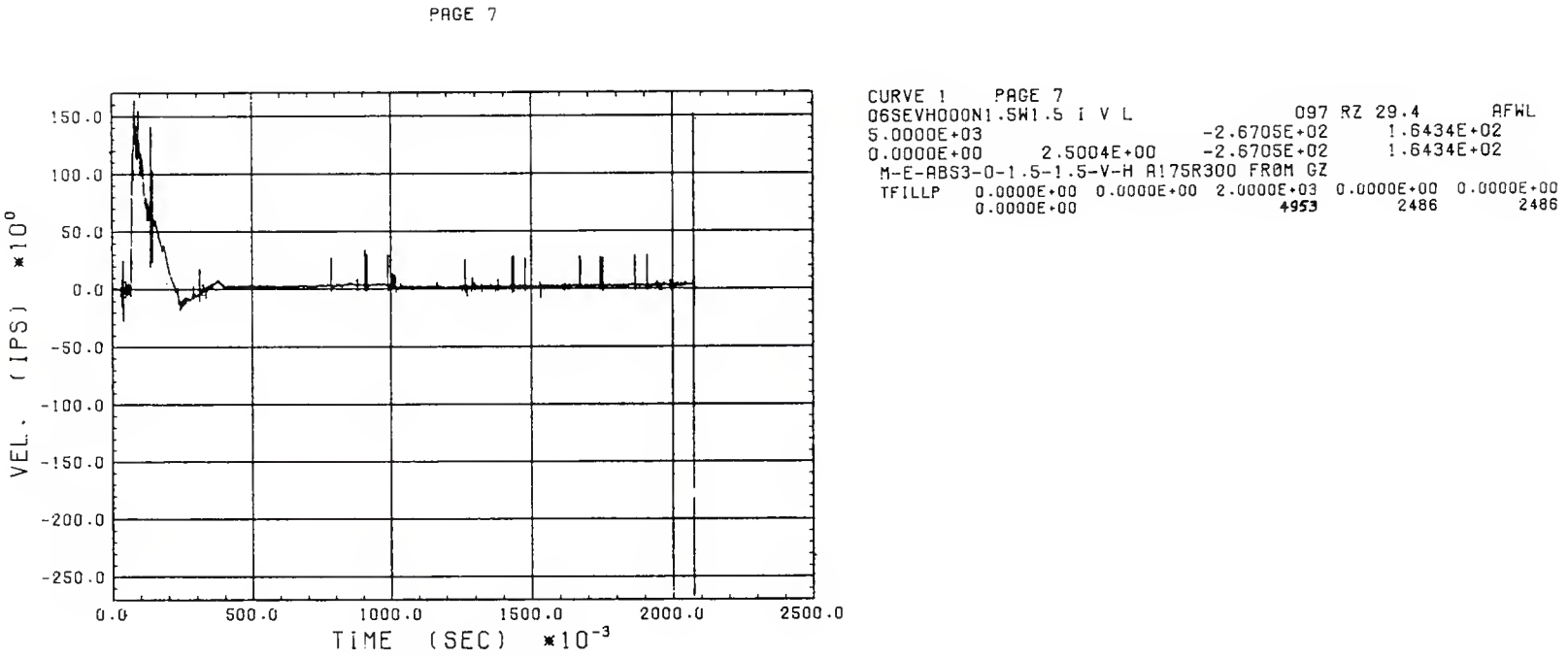
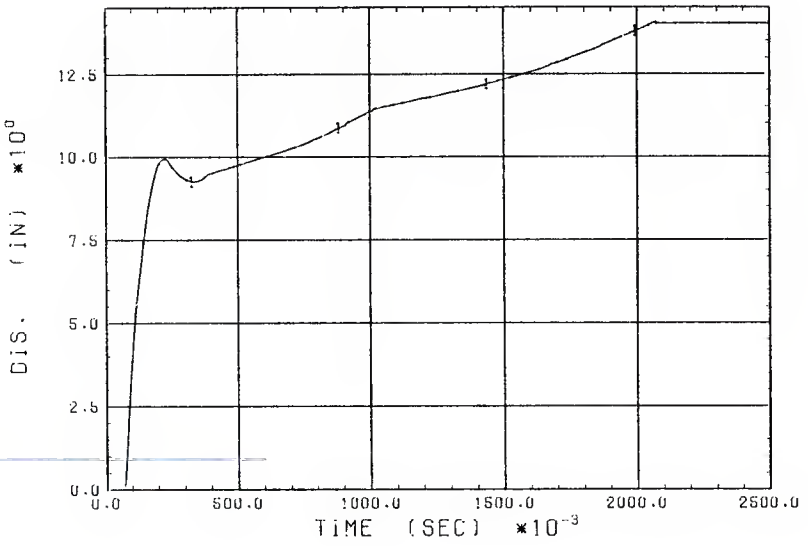


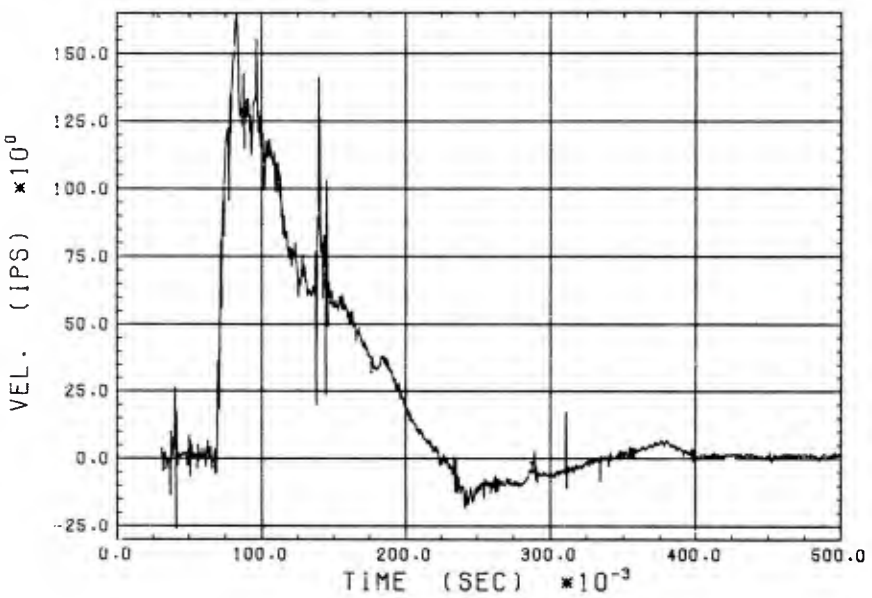
FIGURE B-17. RAW VELOCITY RECORD FILTERED, TFILLP, TO 2000 HZ



CURVE 1 PAGE 8
06SEVHOOON1.5W1.5 I D L1 097 RZ 29.4 AFWL
5.0000E+03 -9.8857E-03 1.4078E+01
0.0000E+00 2.5004E+00 -9.8857E-03 1.4078E+01
M-E-A853-0-1.5--1.5--V-H A175R300 FROM GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	2486	2486
PINT	0.0000E+00				
			0	2486	2486

FIGURE B-18. FILTERED VELOCITY RECORD INTEGRATED, PINT, TO OBTAIN DISPLACEMENT

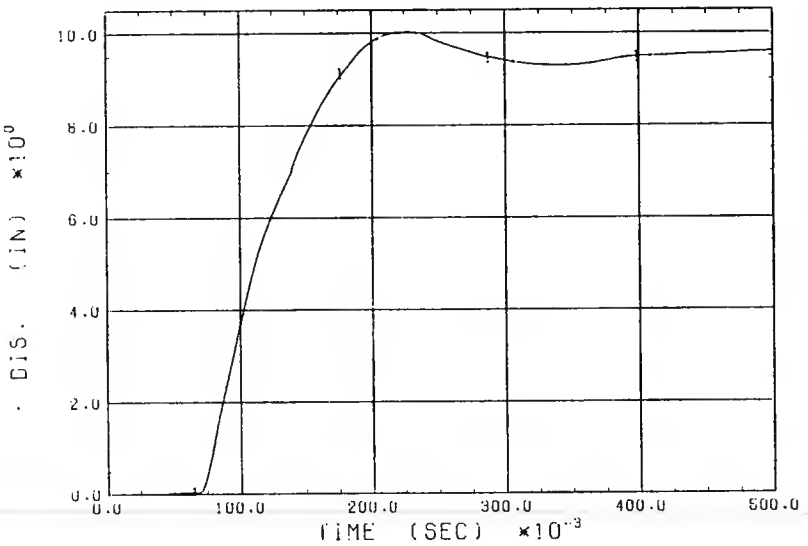


CURVE 1 PAGE 7
06SEVH000N1.5W1.5 I V LTS 097 RZ 29.4 AFWL
5.0000E+03 -2.6266E+01 1.6510E+02
0.0000E+00 5.0000E-01 -2.6266E+01 1.6510E+02
M-E-ABS3-0-1.5-1.5-V-H A175R300 FROM GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		4956	4953	2486
DETN	1.0000E+00	6.0000E-01	2.0000E+03		
			4956	4953	2486
PSTC	0.0000E+00	0.0000E+00	3.1000E-02		
			4956	4953	2486

NOTE: DETN, WITH A LINEAR LEAST SQUARES FIT TO DATA FROM TIME BETWEEN 0.6 AND 1.0 SECONDS AND LINE EXTENDED BACK INTO AND REMOVED FROM TIME 0 TO 0.5 SECONDS. PRESHOCK ARRIVAL NOISE HAS BEEN REMOVED FROM RECORD, PSTC

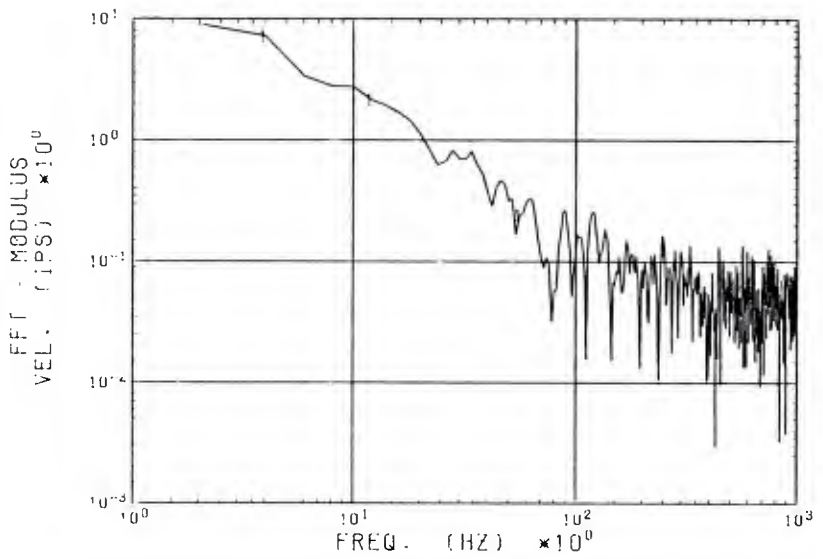
FIGURE B-19. FILTERED VELOCITY RECORD DETRENDED



CURVE 1 PAGE 8
06SEVH000N1.5W1.5 I D LTSi 097 RZ 29.4 AFWL
5.0000E+03 -9.4256E-03 1.0030E+01
0.0000E+00 5.0000E-01 -9.4256E-03 1.0030E+01
M-E-ABS3-0-1.5-1.5-V-H A175R300 FROM GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4953	2486
CETN	1.0000E+00	6.0000E-01	2.0000E+03		
			0	4953	2486
PSTC	0.0000E+00	0.0000E+00	3.1000E-02		
			0	4953	2486
PINT	0.0000E+00				
			0	4953	2486

FIGURE B-20. CLEANED-UP VELOCITY RECORD INTEGRATED, PINT, TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 9
06SEVH000N1.5W1.5 IFV LTSAF 097 RZ 29.4 AFWL
5.0000E-01 2.9352E-03 9.0473E+00
2.0000E+00 1.0000E+03 2.9352E-03 9.0473E+00
M-E-ABS3--0-1.5-1.5-V-H A175R300 FROM GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00	
	0.0000E+00		0	4953	2486	
DETN	1.0000E+00	6.0000E-01	2.0000E+03			
			0	4953	2486	
PSTC	0.0000E+00	0.0000E+00	3.1000E-02			
			0	4953	2486	
FBUR	2.5000E+03	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
			0	4953	2486	
CPOL	0.0000E+00					
			0	4953	2486	

FIGURE B-21. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP VELOCITY RECORD WITH REAR 10% OF RECORD COSINE TAPERED

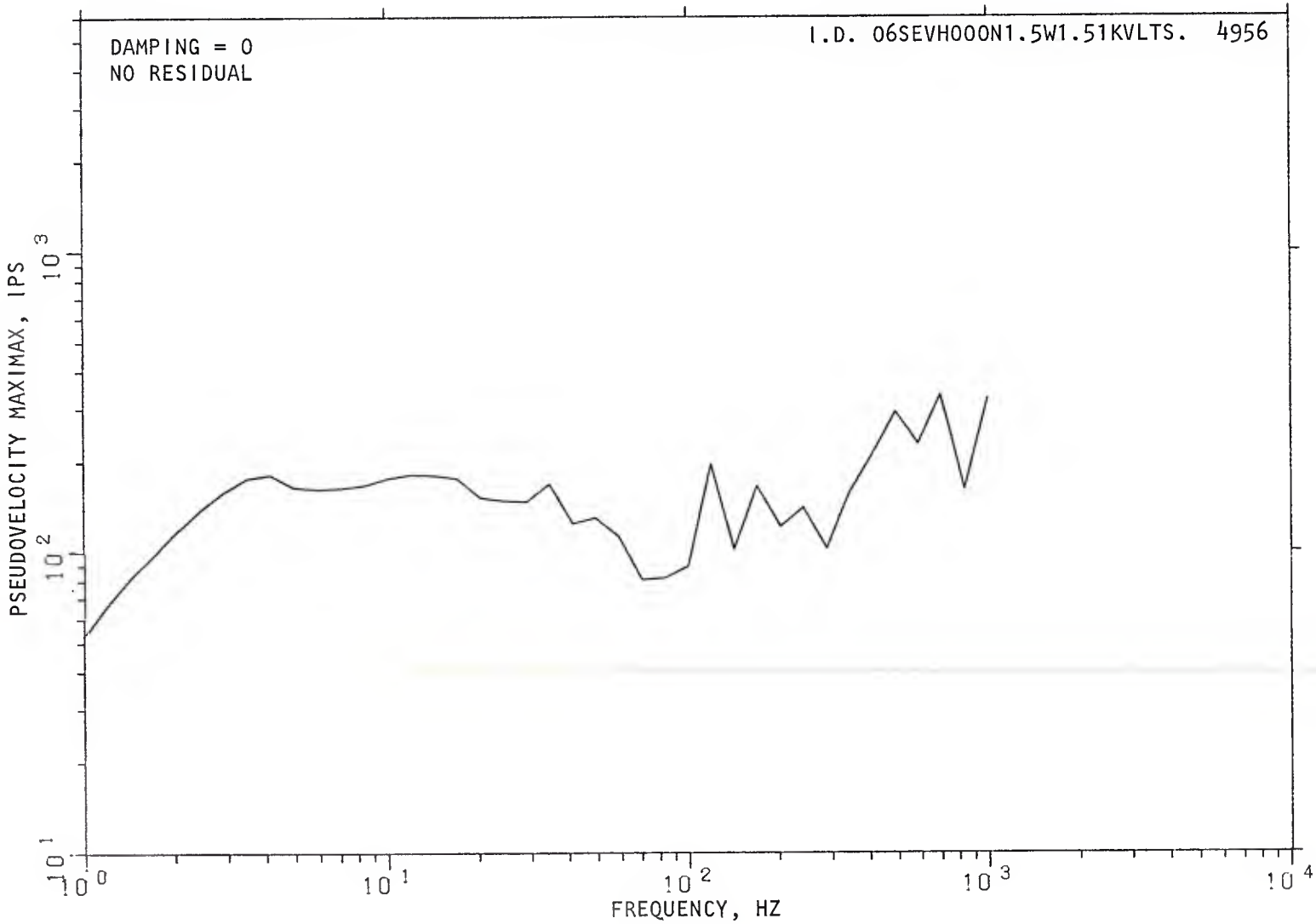
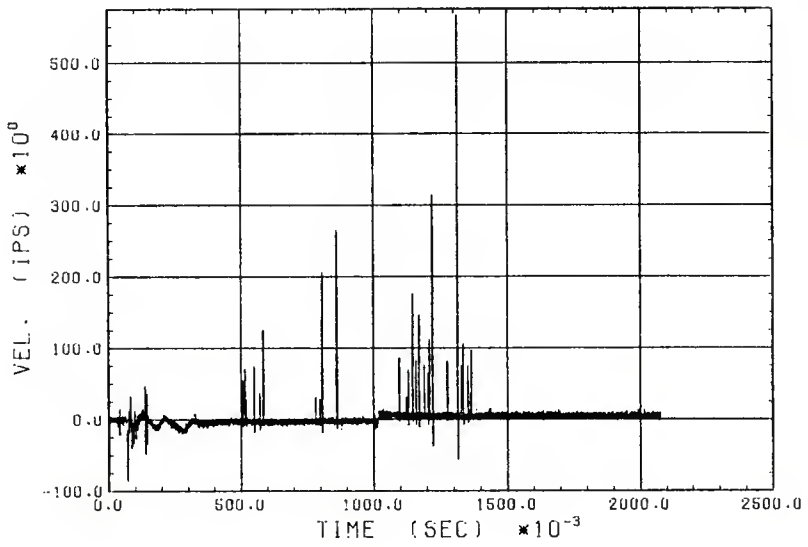


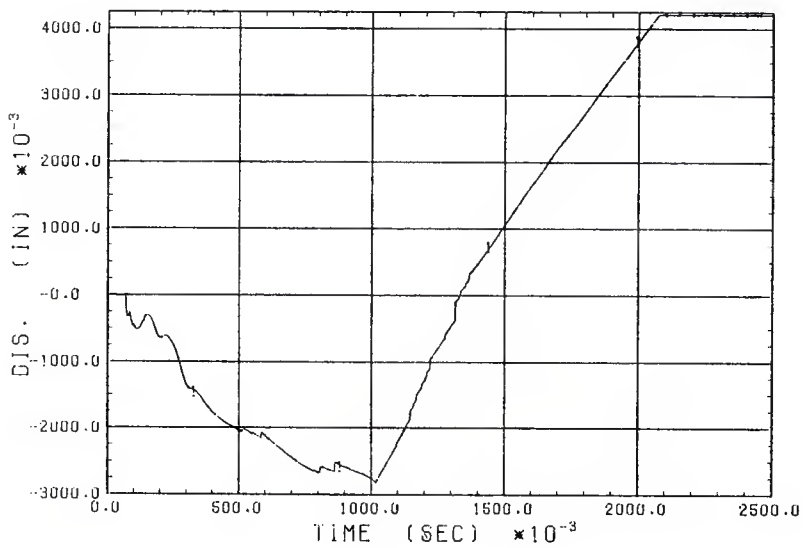
FIGURE B-22. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP VELOCITY RECORD WITH NO DAMPING AND NO RESIDUAL

FILE 2558



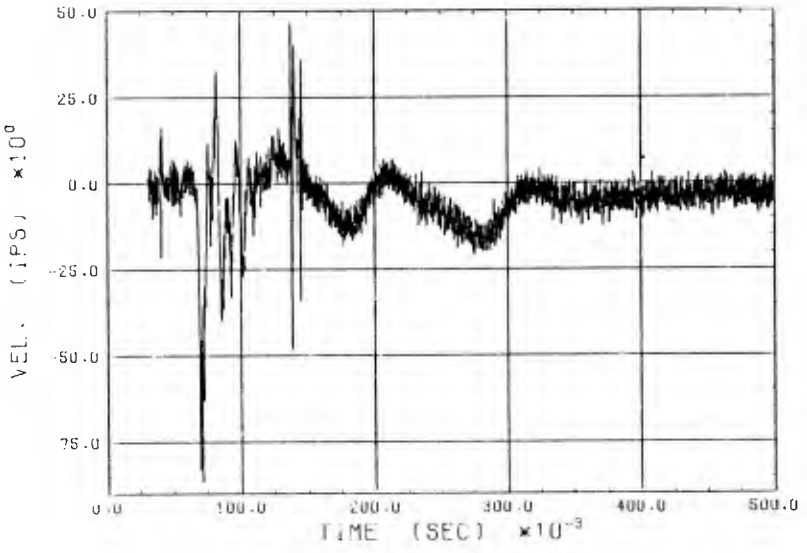
CURVE 1 PAGE 3
06SEVV000N1.5W1.5 I V L 084 RZ 30.4 AFWL
5.0000E+03 -8.6599E+01 5.6708E+02
0.0000E+00 2.4994E+00 -8.6599E+01 5.6708E+02
M-E-ABS3-0-1.5-1.5-V-V A175R300 FROM GZ
TFILLP 0.0000E+00 0.0000E+00 2.0000E+03 0.0000E+00 0.0000E+00
0.0000E+00 4951 2558 2558

FIGURE B-23. RAW VELOCITY RECORD FILTERED, TFILLP, TO 2000 HZ




```
CURVE 1     PAGE 4
06SEVV000N1.5W1.5 I D L.I                    084 RZ 30.4        AFWL
5.0000E+03                        -2.8187E+00      4.2140E+00
0.0000E+00      2.4994E+00        -2.8187E+00      4.2140E+00
 M-E-ABS3-0-1.5-1.5-V-V A175R300 FROM GZ
 TFILLP   0.0000E+00  0.0000E+00  2.0000E+03  0.0000E+00  0.0000E+00
          0.0000E+00                      0        2558        2558
 PINT     0.0000E+00
                                          0        2558        2558
```

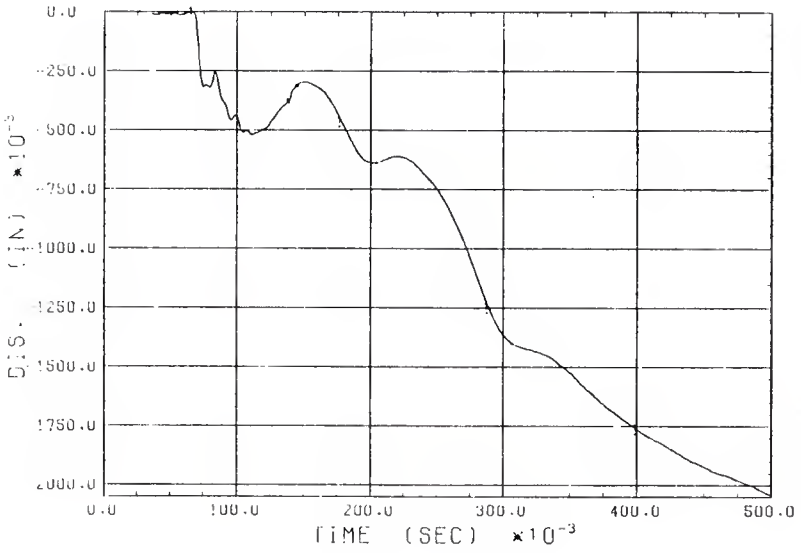
FIGURE B-24. FILTERED VELOCITY RECORD INTEGRATED, PINT, TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 10
06SEVVOOON1.5W1.5 I V LS 084 RZ 30.4 AFWL
5.0000E+03 -8.6599E+01 4.6685E+01
0.0000E+00 5.0000E-01 -8.6599E+01 4.6685E+01
M-E-ABS3--0--1.5--1.5-V-V A175R300 FROM GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		4957	4951	2558
PSTC	0.0000E+00	0.0000E+00	3.1000E-02		
			4957	4951	2558

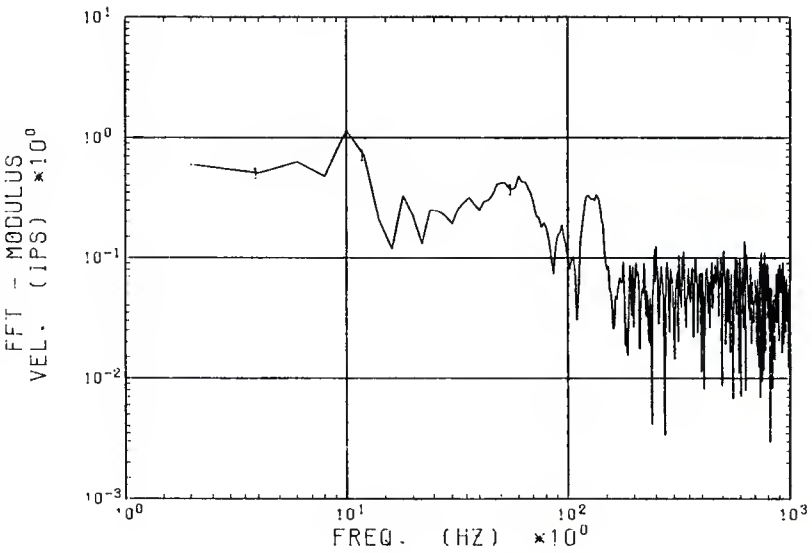
FIGURE B-25. FILTERED VELOCITY RECORD WITH PRESHOCK ARRIVAL NOISE REMOVED, PSTC



CURVE 1 PAGE 11
06SEVVOOON1.5W1.5 1 D LSI 084 RZ 30.4 AFWL
5.0000E+03 -2.0438E+00 1.3187E-03
0.0000E+00 5.0000E-01 -2.0438E+00 1.3187E-03
M-E-ABS3-0-1.5-1.5-V-V A175R300 FROM GZ

IFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00	
	0.0000E+00		0	4951	2558	
PSTC	0.0000E+00	0.0000E+00	3.1000E-02			
			0	4951	2558	
PINT	0.0000E+00					
			0	4951	2558	

FIGURE B-26. CLEANED-UP VELOCITY RECORD INTEGRATED, PINT, TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 12
06SEVV000N1.5W1.5 IFV LSAF 084 RZ 30.4 AFWL
5.0000E-01 2.9815E-03 1.1519E+00
2.0000E+00 1.0000E+03 2.9815E-03 1.1519E+00
M-E-ABS3--0-1.5-1.5--V-V A175R300 FR0M GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4951	2558
PSTC	0.0000E+00	0.0000E+00	3.1000E-02		
			0	4951	2558
F0UR	2.5000E+03	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4951	2558
CP0L	0.0000E+00				
			0	4951	2558

FIGURE B-27. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP VELOCITY RECORD WITH REAR 10% OF RECORD COSINE TAPERED

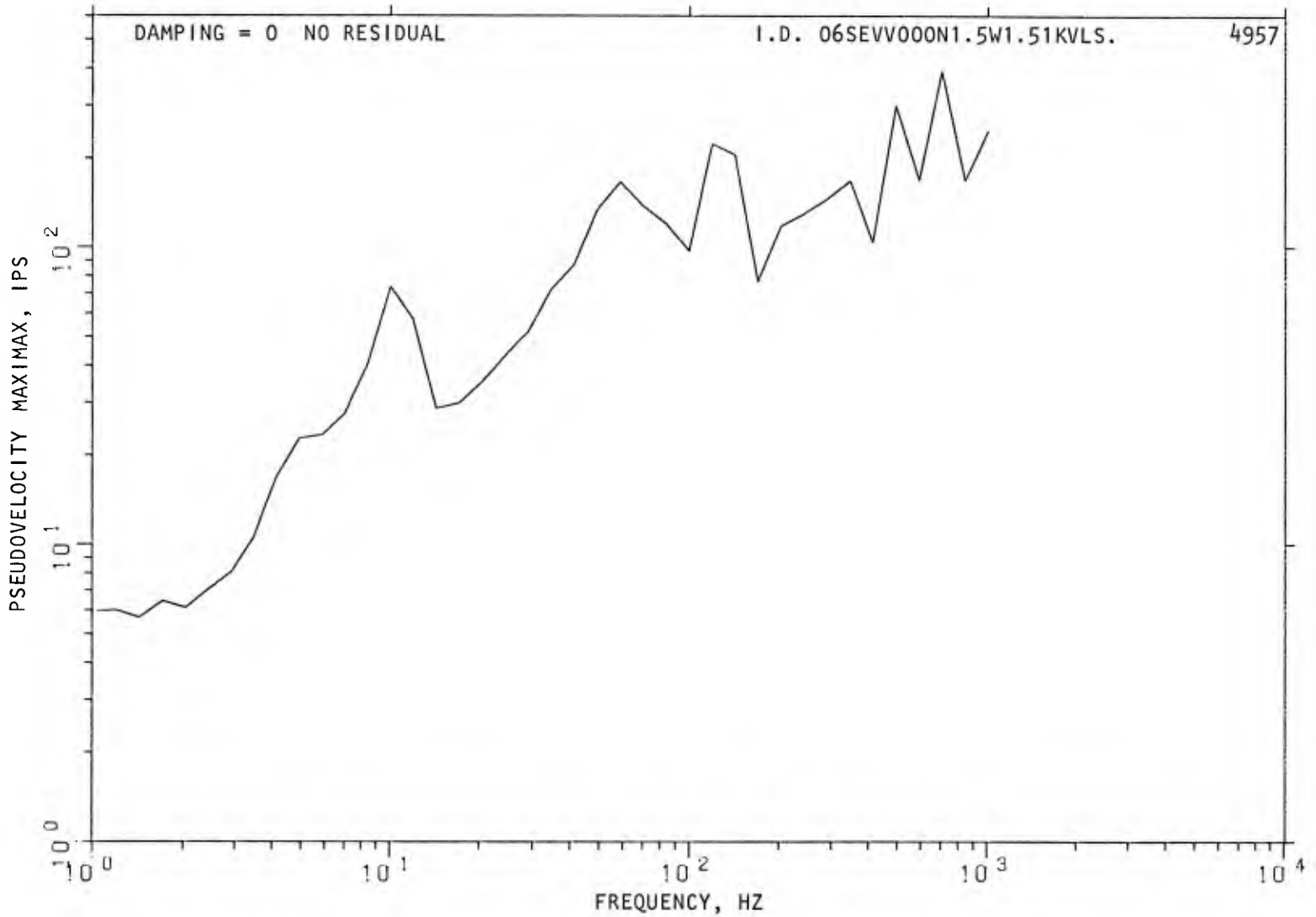
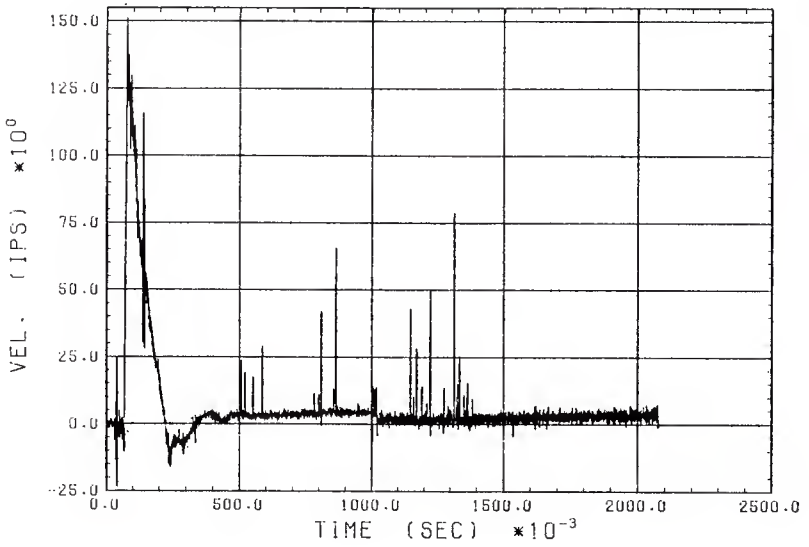


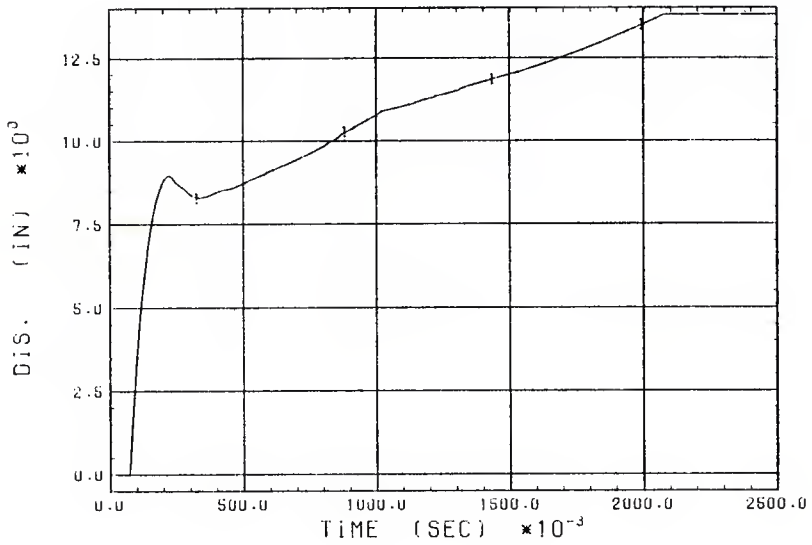
FIGURE B-28. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP VELOCITY RECORD WITH NO DAMPING AND NO RESIDUAL

FILE 2549



CURVE 1 PAGE 1
06SEVH0OON10.W1.5 I V L 098 RZ 30.4 AFWL
5.0000E+03 -2.3380E+01 1.5134E+02
0.0000E+00 2.4994E+00 -2.3380E+01 1.5134E+02
M-E-ABS3-0-10.5-1.5-V-H A175R300 FR0M GZ
TFILLP 0.0000E+00 0.0000E+00 2.0000E+03 0.0000E+00 0.0000E+00
0.0000E+00 4950 2549 2549

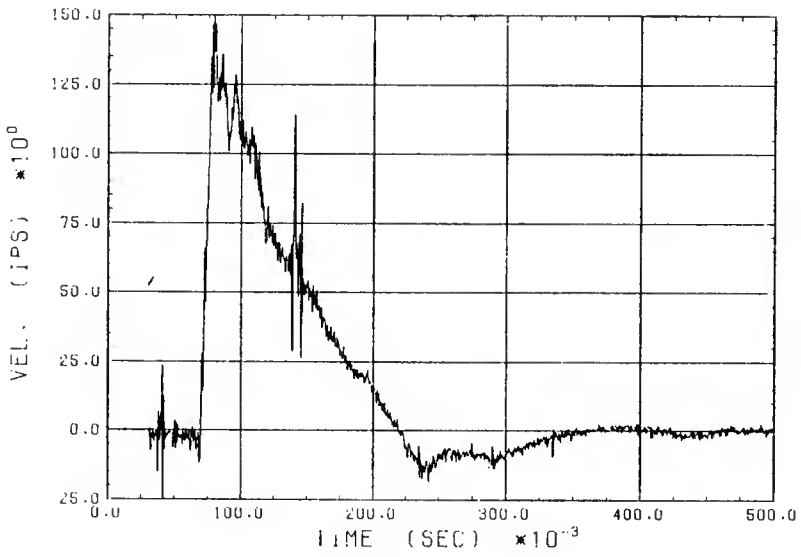
FIGURE B-29. RAW VELOCITY RECORD FILTERED, TFILLP, TO 2000 HZ



CURVE 1 PAGE 2
06SEVH000N10.W1.5 I D LI 098 RZ 30.4 AFWL
5.0000E+03 -3.6614E-02 1.3798E+01
0.0000E+00 2.4994E+00 -3.6614E-02 1.3798E+01
M-E-ABS3--0-10.5-1.5-V-H A175R300 FROM GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	2549	2549
PINT	0.0000E+00				
			0	2549	2549

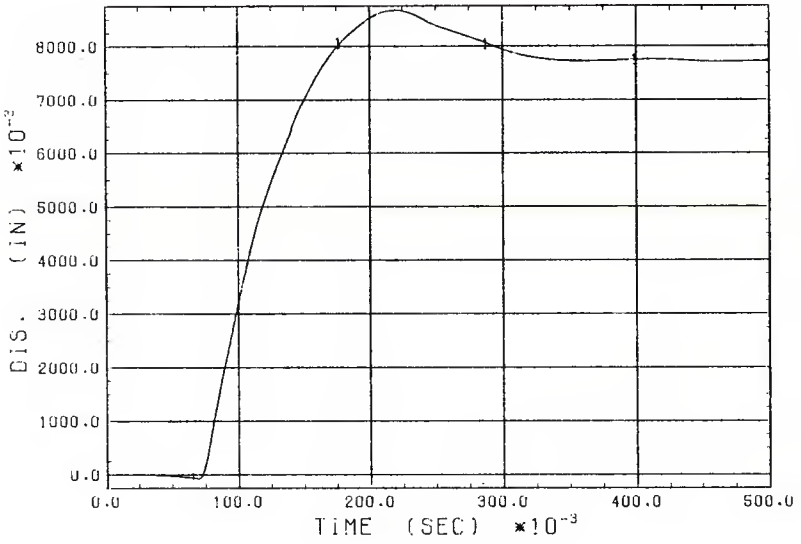
FIGURE B-30. FILTERED VELOCITY RECORD INTEGRATED, PINT, TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 1
06SEVHOOON10.W1.5 I V LTS 098 RZ 30.4 AFWL
5.0000E+03 -2.4659E+01 1.4991E+02
0.0000E+00 5.0000E-01 -2.4659E+01 1.4991E+02
M-E-ABS3-0-10.5--1.5--V-H A175R300 FROM GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		4954	4950	2549
DETN	1.0000E+00	6.0000E-01	2.0000E+03		
			4954	4950	2549
PSTC	0.0000E+00	0.0000E+00	3.1000E-02		
			4954	4950	2549

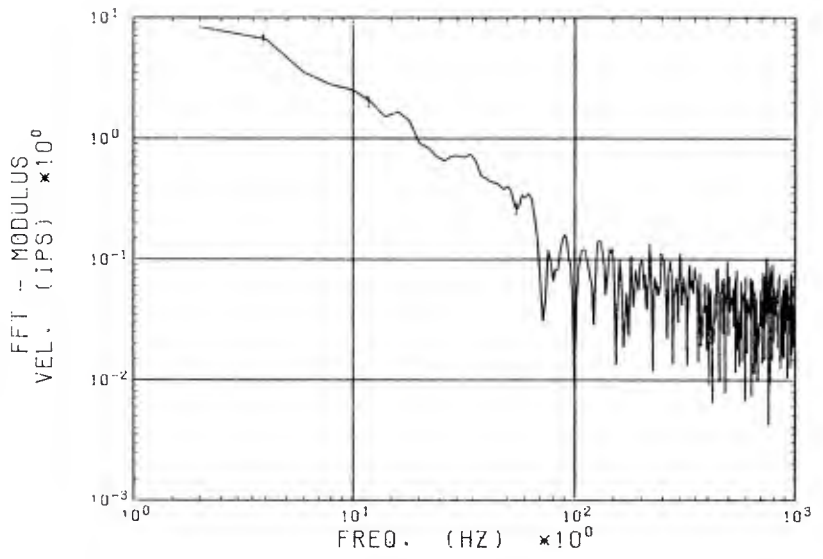
FIGURE B-31. FILTERED VELOCITY RECORD DETRENDED, DETN, WITH A LINEAR LEAST SQUARES FIT TO DATA FROM TIME BETWEEN 0.6 AND 1.0 SECONDS AND LINE EXTENDED BACK INTO AND REMOVED FROM TIME 0 TO 0.5 SECONDS. PRESHOCK ARRIVAL NOISE HAS BEEN REMOVED FROM RECORD, PSTC



CURVE 1 PAGE 2
06SEVH0O0N10.W1.5 I D LTSi 098 RZ 30.4 AFWL
5.0000E+03 -8.2720E-02 8.6686E+00
0.0000E+00 5.0000E-01 -8.2720E-02 8.6686E+00
M-E-ABS3--0-10.5--1.5-V-H A175R300 FR0M GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4950	2549
DETN	1.0000E+00	6.0000E-01	2.0000E+03		
			0	4950	2549
PSTC	0.0000E+00	0.0000E+00	3.1000E-02		
			0	4950	2549
PINT	0.0000E+00				
			0	4950	2549

FIGURE B-32. CLEANED-UP VELOCITY RECORD INTEGRATED, PINT, TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 3
OGSEVHOOON10.W1.5 IFV LTSAF 098 RZ 30.4 AFWL
5.0000E-01 4.2085E-03 8.2973E+00
2.0000E+00 1.0000E+03 4.2085E-03 8.2973E+00
M-E-ABS3-0-10.5-1.5-V-H A175R300 FROM CZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4950	2549
DETN	1.0000E+00	6.0000E-01	2.0000E+03		
			0	4950	2549
PSTC	0.0000E+00	0.0000E+00	3.1000E-02		
			0	4950	2549
FOUR	2.5000E+03	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4950	2549
CPOL	0.0000E+00				
			0	4950	2549

FIGURE B-33. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP VELOCITY RECORD WITH REAR 10% OF RECORD COSINE TAPERED

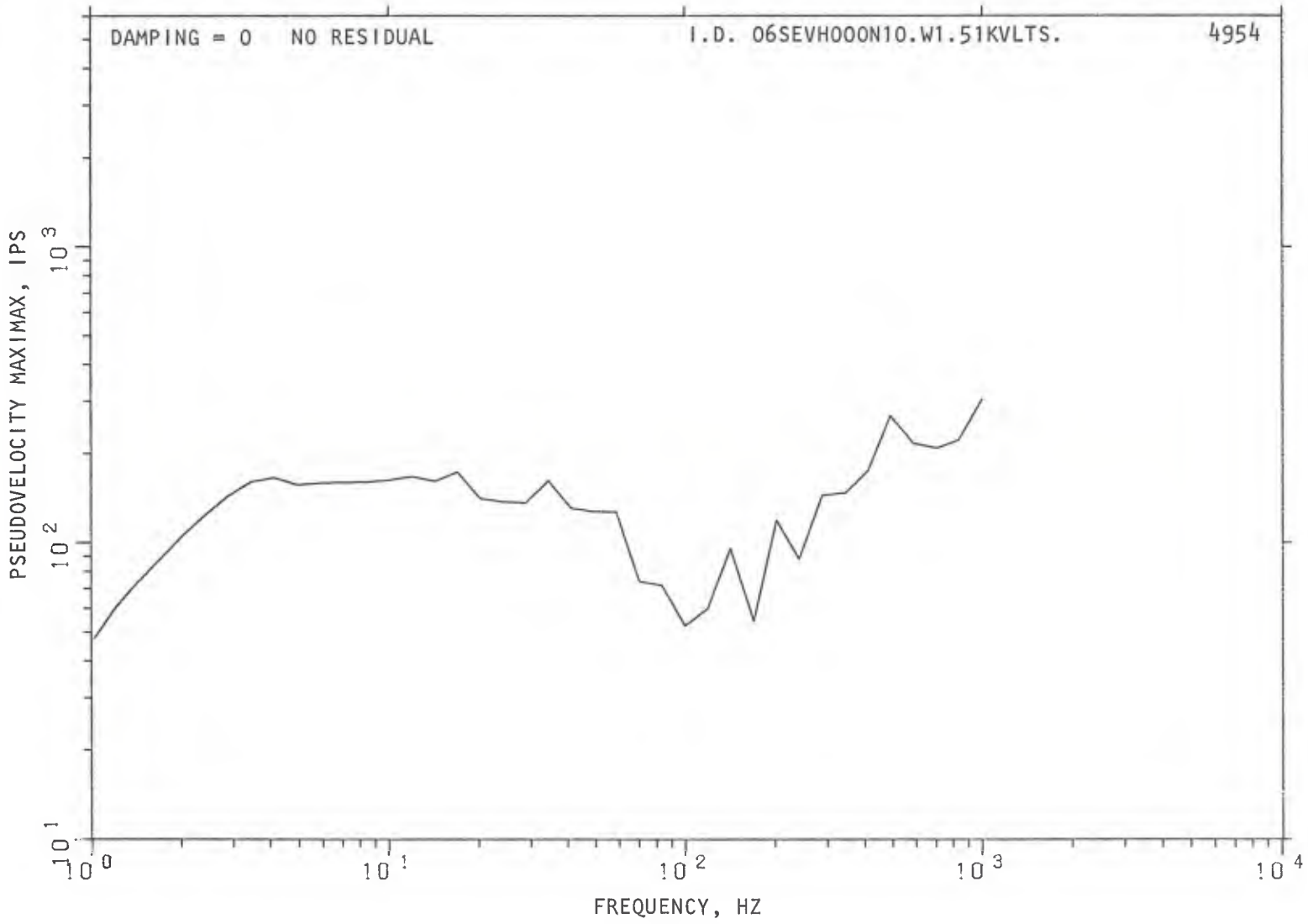
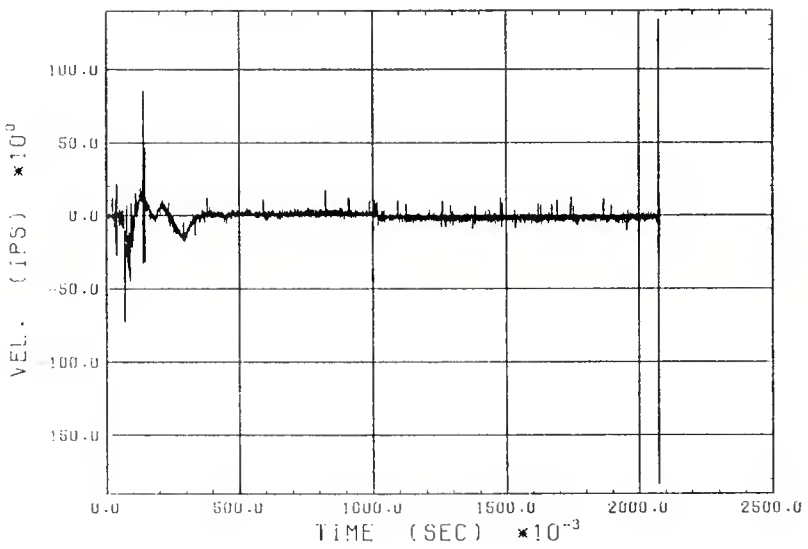


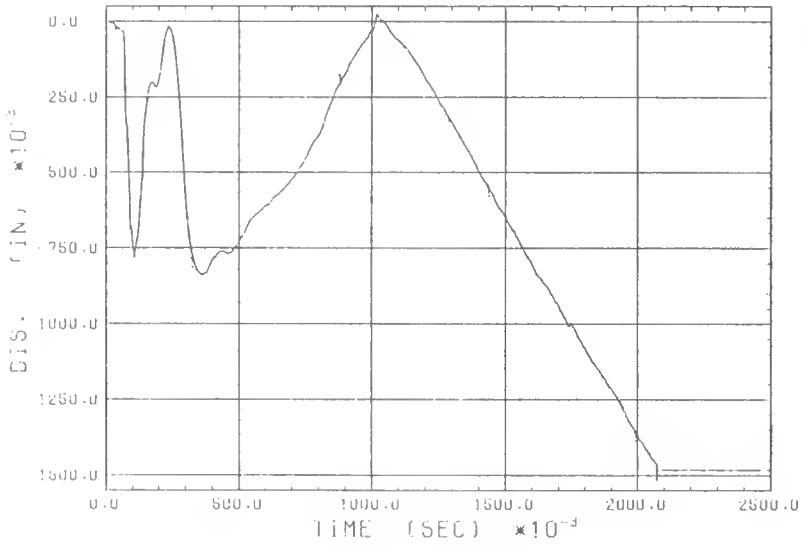
FIGURE B-34. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP VELOCITY RECORD WITH NO DAMPING AND NO RESIDUAL

FILE 2463



CURVE 1 PAGE 5
06SEVV000N10.W1.5 I V L 086 RZ 29.4 AFWL
5.0000E+03 -1.8322E+02 1.3442E+02
0.0000E+00 2.5004E+00 -1.8322E+02 1.3442E+02
M-E-ABS3--0--10.5-1.5-V--V A175R300 FROM GZ
TFILLP 0.0000E+00 0.0000E+00 2.0000E+03 0.0000E+00 0.0000E+00
0.0000E+00 2463 2463

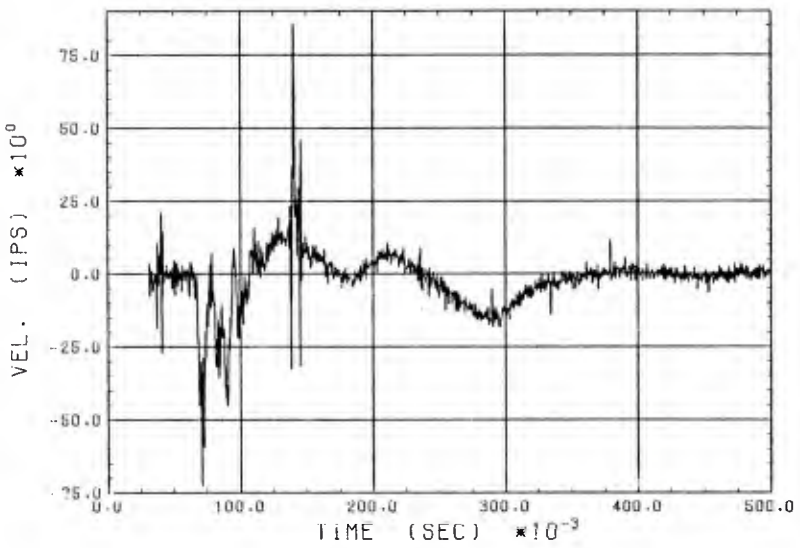
FIGURE B-35. RAW VELOCITY RECORD FILTERED, TFILLP, TO 2000 HZ



CURVE 1 PAGE 6
06SEVV000N10.W1.5 1 0 LI 086 RZ 29.4 AFWL
5.0000E+03 -1.5160E+00 2.4949E-02
0.0000E+00 2.5004E+00 -1.5160E+00 2.4949E-02
M-E-ABS3--0--10.5--1.5--V--V A175R300 FROM GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00	
	0.0000E+00		0	2463	2463	
PINT	0.0000E+00		0	2463	2463	

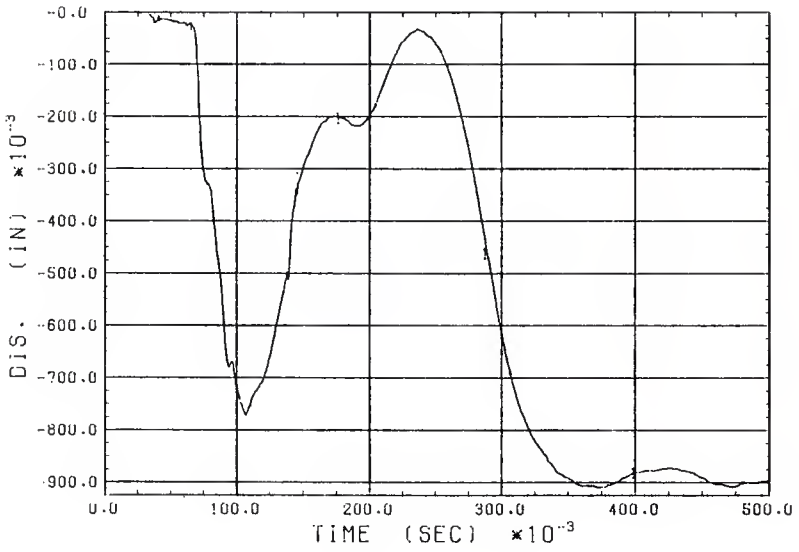
FIGURE B-36. FILTERED VELOCITY RECORD INTEGRATED, PINT, TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 4
06SEVVOOON10.W1.5 I V LTS 086 RZ 29.4 AFWL
5.0000E+03 -7.2679E+01 8.5824E+01
0.0000E+00 5.0000E-01 -7.2679E+01 8.5824E+01
M-E-ABS3-0-10.5-1.5-V-V A175R300 FROM GZ

TFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		4955	4952	2463
DETN	1.0000E+00	6.0000E-01	2.0000E+03		
			4955	4952	2463
PSTC	0.0000E+00	0.0000E+00	3.1000E-02		
			4955	4952	2463

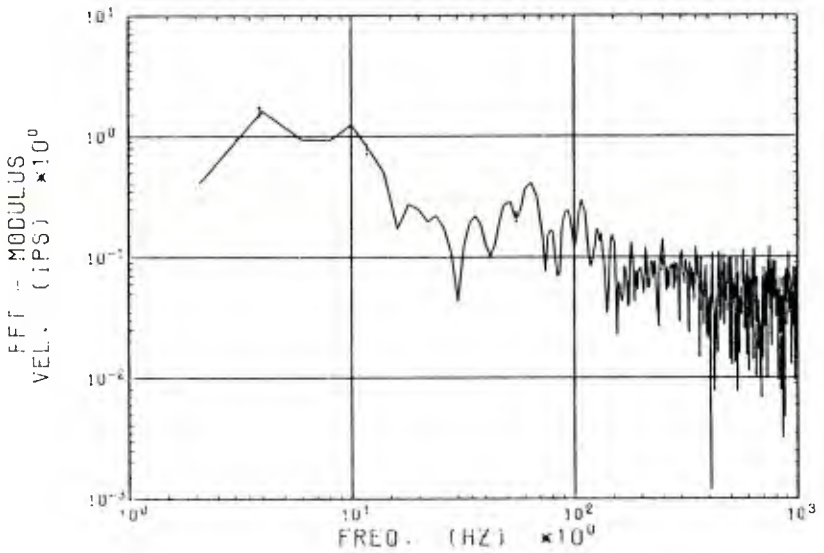
FIGURE B-37. FILTERED VELOCITY RECORD DETRENDED, DETN, WITH A LINEAR LEAST SQUARES FIT TO DATA FROM TIME BETWEEN 0.6 AND 1.0 SECONDS AND LINE EXTENDED BACK INTO AND REMOVED FROM TIME 0 TO 0.5 SECONDS. PRESHOCK ARRIVAL NOISE HAS BEEN REMOVED FROM RECORD, PSTC



CURVE 1 PAGE 5
06SEVV000N10.W1.5 I D LFSI 086 RZ 29.4 AFWL
5.0000E+03 -9.1013E-01 6.6465E-04
0.0000E+00 5.0000E-01 -9.1013E-01 6.6465E-04
M-E-ABS3-0-10.5-1.5-V-V A175R300 FROM GZ

IFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00	
	0.0000E+00		0	4952	2463	
DETN	1.0000E+00	6.0000E-01	2.0000E+03			
			0	4952	2463	
PSTC	0.0000E+00	0.0000E+00	3.1000E-02			
			0	4952	2463	
PINT	0.0000E+00					
			0	4952	2463	

FIGURE B-38. CLEANED-UP VELOCITY RECORD INTEGRATED, PINT, TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 6
06SEVVOOON10.W1.5 IFV LTSAF 086 RZ 29.4 AFWL
5.0000E-01 1.1853E-03 1.6193E+00
2.0000E+00 1.0000E+03 1.1853E-03 1.6193E+00
M-E-ABS3-0-10.5-1.5-V-V A175R300 FR0M GZ

IFILLP	0.0000E+00	0.0000E+00	2.0000E+03	0.0000E+00	0.0000E+00
	0.0000E+00		0	4952	2463
DETN	1.0000E+00	6.0000E-01	2.0000E+03		
			0	4952	2463
PSTC	0.0000E+00	0.0000E+00	3.1000E-02		
			0	4952	2463
F0UR	2.5000E+03	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4952	2463
CP0L	0.0000E+00				
			0	4952	2463

FIGURE B-39. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP VELOCITY RECORD WITH REAR 10% OF RECORD COSINE TAPERED

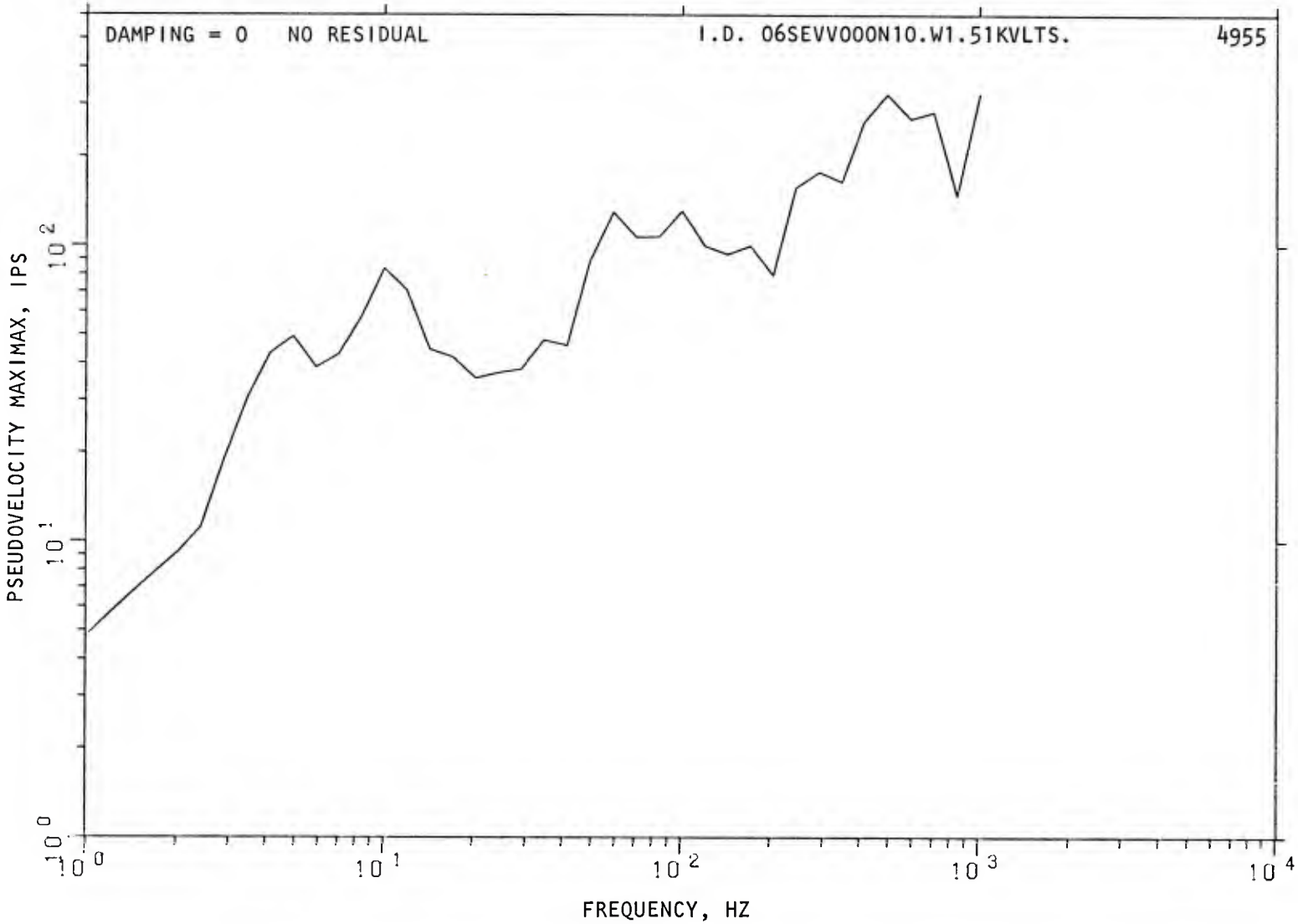


FIGURE B-40. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP VELOCITY RECORD WITH NO DAMPING AND NO RESIDUAL

APPENDIX C

Processed Data from the Second Request from the Boeing Aerospace Company

FILE 2923

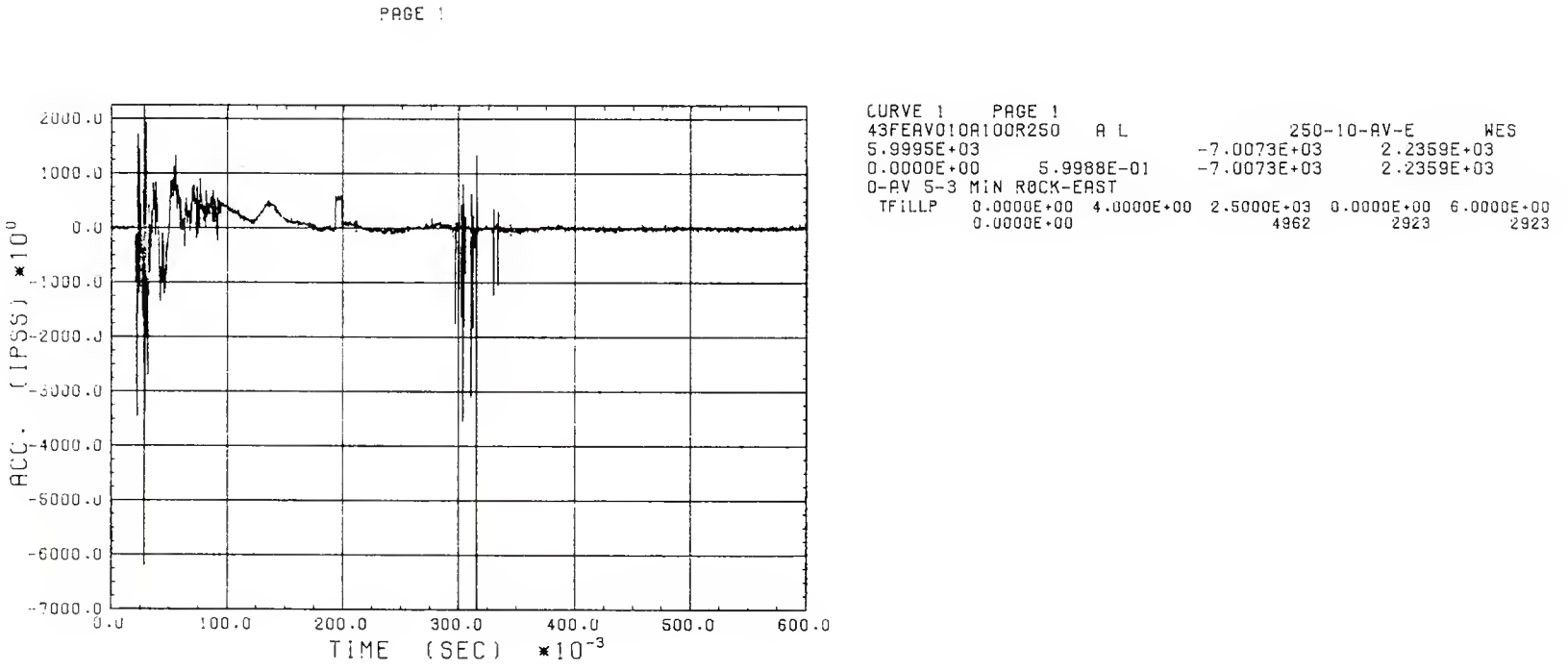
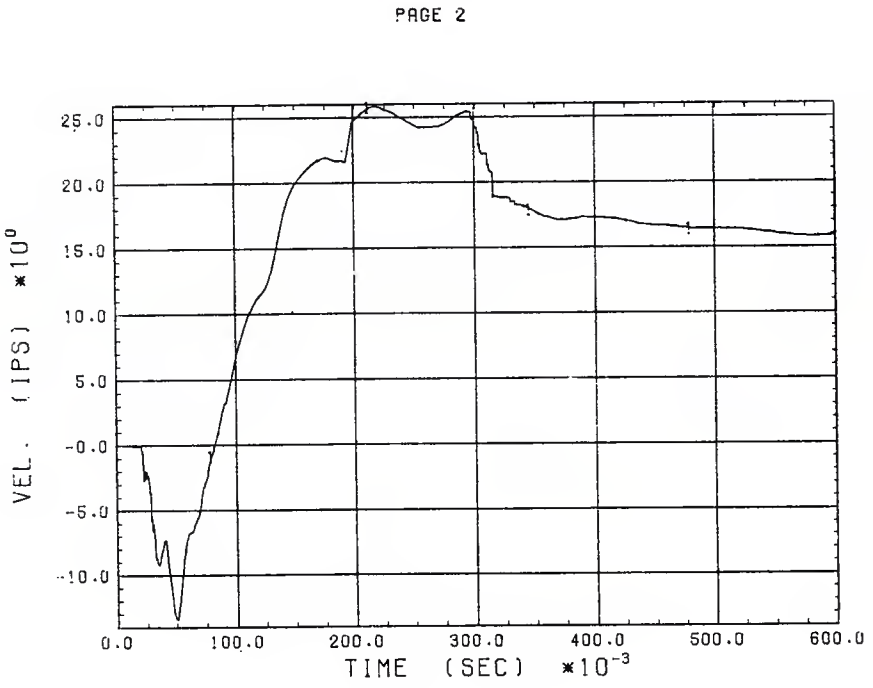
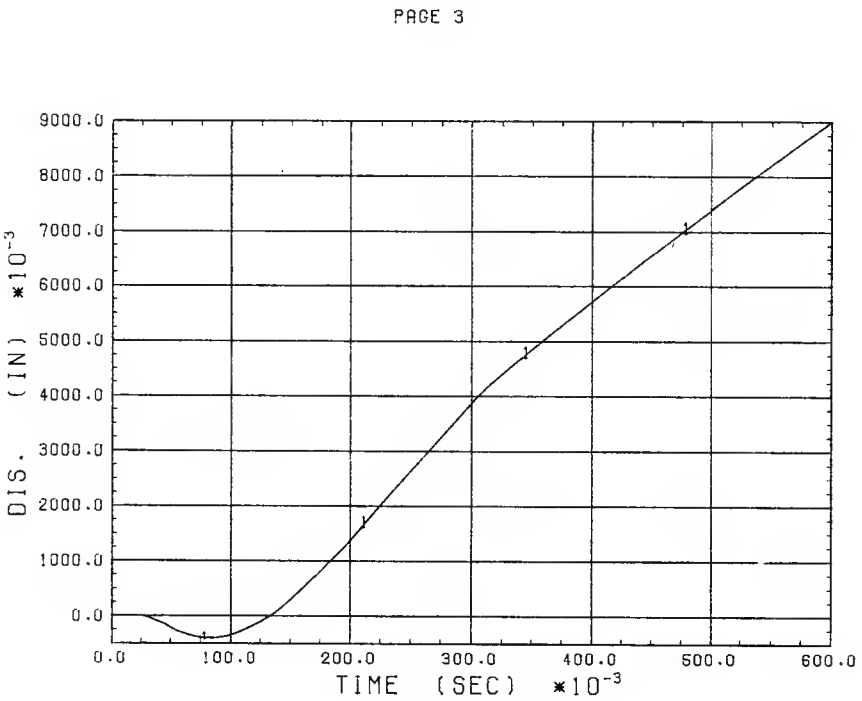


FIGURE C-1. RAW ACCELERATION RECORD FILTERED, TFILLP, TO 2500 HZ AND DECIMATED TO 6000 SAMPLES/SECOND




```
CURVE 1    PAGE 2
43FEAV010A100R250    V LI                250-10-AV-E       WES
5.9995E+03                        -1.3446E+01      2.5853E+01
0.0000E+00      5.9988E-01        -1.3446E+01      2.5853E+01
0-AV 5-3 MIN ROCK-EAST
 TFILLP    0.0000E+00  4.0000E+00  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                      0        2923        2923
 PINT      0.0000E+00
                                           0        2923        2923
```

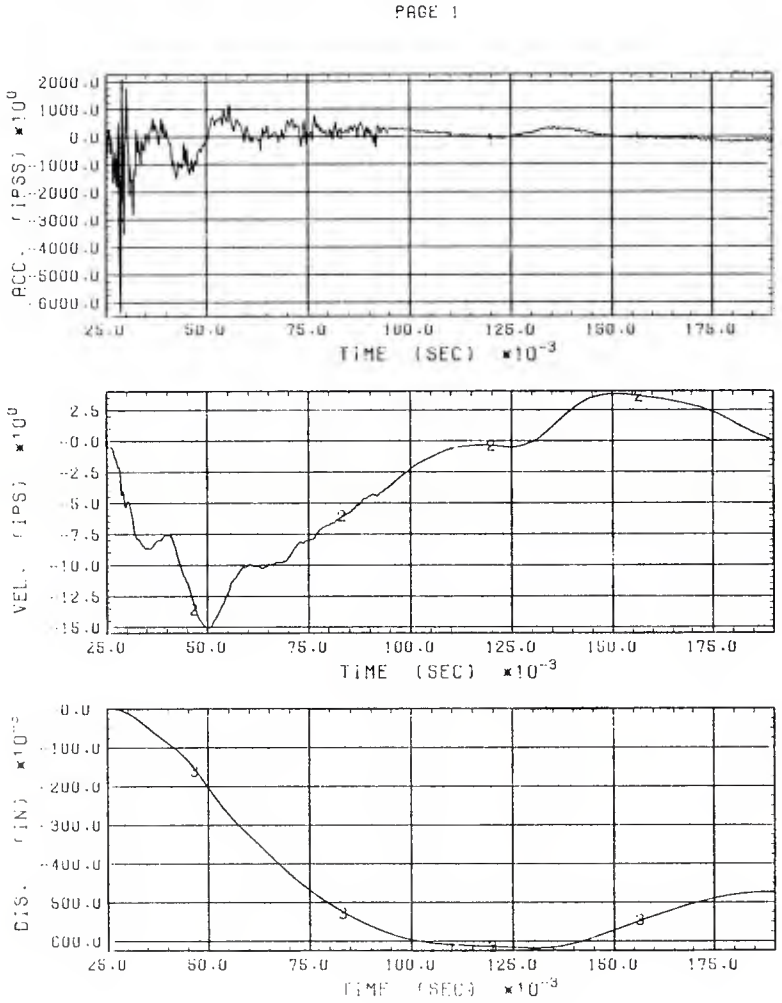
FIGURE C-2. FILTERED ACCELERATION RECORD INTEGRATED, PINT, TO OBTAIN VELOCITY



CURVE 1 PAGE 3
43FEAV010A100R250 D LII 250-10-AV-E WES
5.9995E+03 -4.0490E-01 9.0046E+00
0.0000E+00 5.9988E-01 -4.0490E-01 9.0046E+00
0-AV 5-3 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	2923	2923
PINT	0.0000E+00				
			0	2923	2923
PINT	0.0000E+00				
			0	2923	2923

FIGURE C-3. FILTERED ACCELERATION RECORD DOUBLE INTEGRATED, PINT AND PINT, TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 1
43FEAV01OA100R250 A LT 250-10-AV-E WES
5.9995E+03 -6.3496E+03 2.0921E+03
2.5002E-02 1.8985E-01 -6.3496E+03 2.0921E+03
0-AV 5-3 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00	
	0.0000E+00		4974	4962	2923	
DETN	0.0000E+00	0.0000E+00	0.0000E+00			
			4974	4962	2923	

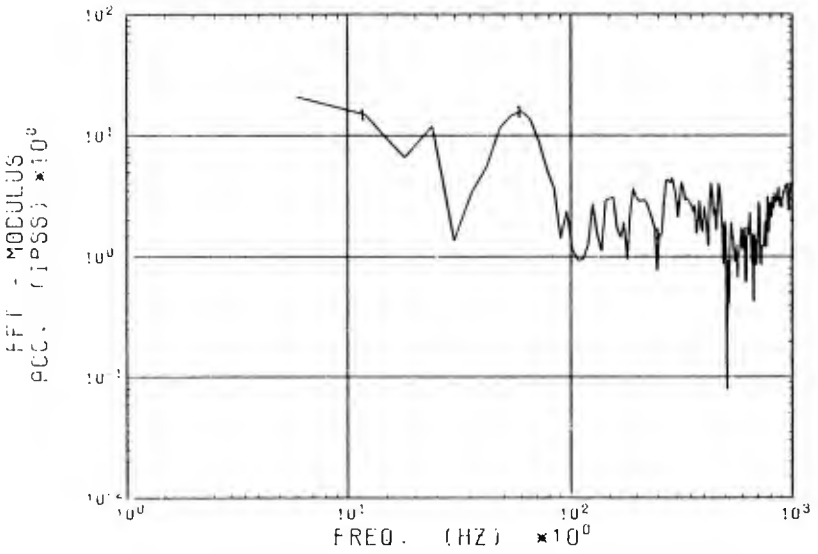
CURVE 2 PAGE 1
43FEAV01OA100R250 V LTi 250-10-AV-E WES
5.9995E+03 -1.5080E+01 3.7989E+00
2.5002E-02 1.8985E-01 -1.5080E+01 3.7989E+00
0-AV 5-3 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00	
	0.0000E+00		0	4962	2923	
DETN	0.0000E+00	0.0000E+00	0.0000E+00			
			0	4962	2923	
PINT	0.0000E+00					
			0	4962	2923	

CURVE 3 PAGE 1
43FEAV01OA100R250 D LTii 250-10-AV-E WES
5.9995E+03 -6.1779E-01 -2.6074E-05
2.5002E-02 1.8985E-01 -6.1779E-01 -2.6074E-05
0-AV 5-3 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00	
	0.0000E+00		0	4962	2923	
DETN	0.0000E+00	0.0000E+00	0.0000E+00			
			0	4962	2923	
PINT	0.0000E+00					
			0	4962	2923	
PINT	0.0000E+00					
			0	4962	2923	

FIGURE C-4. FILTERED ACCELERATION RECORD DETRENDED, DETN, WITH AN OFFSET LEAST SQUARES FIT TO DATA FROM TIME BETWEEN 0.025 AND 0.190 SECONDS, INTEGRATED, PINT, TO OBTAIN VELOCITY, AND DOUBLE INTEGRATED, PINT AND PINT, TO OBTAIN DISPLACEMENT. PRESHOCK ARRIVAL NOISE HAS BEEN REMOVED



CURVE 1 PAGE 2
43FEAV010A100R250 FA LTAF 250-10-AV-E WES
1.6668E-01 7.9766E-02 2.0730E+01
5.9995E+00 9.9592E+02 7.9766E-02 2.0730E+01
0-AV 5-3 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4962	2923
CETN	0.0000E+00	0.0000E+00	0.0000E+00		
			0	4962	2923
FOUR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4962	2923
CPOL	0.0000E+00				
			0	4962	2923

FIGURE C-5. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP ACCELERATION RECORD WITH REAR 10% OF RECORD COSINE TAPERED

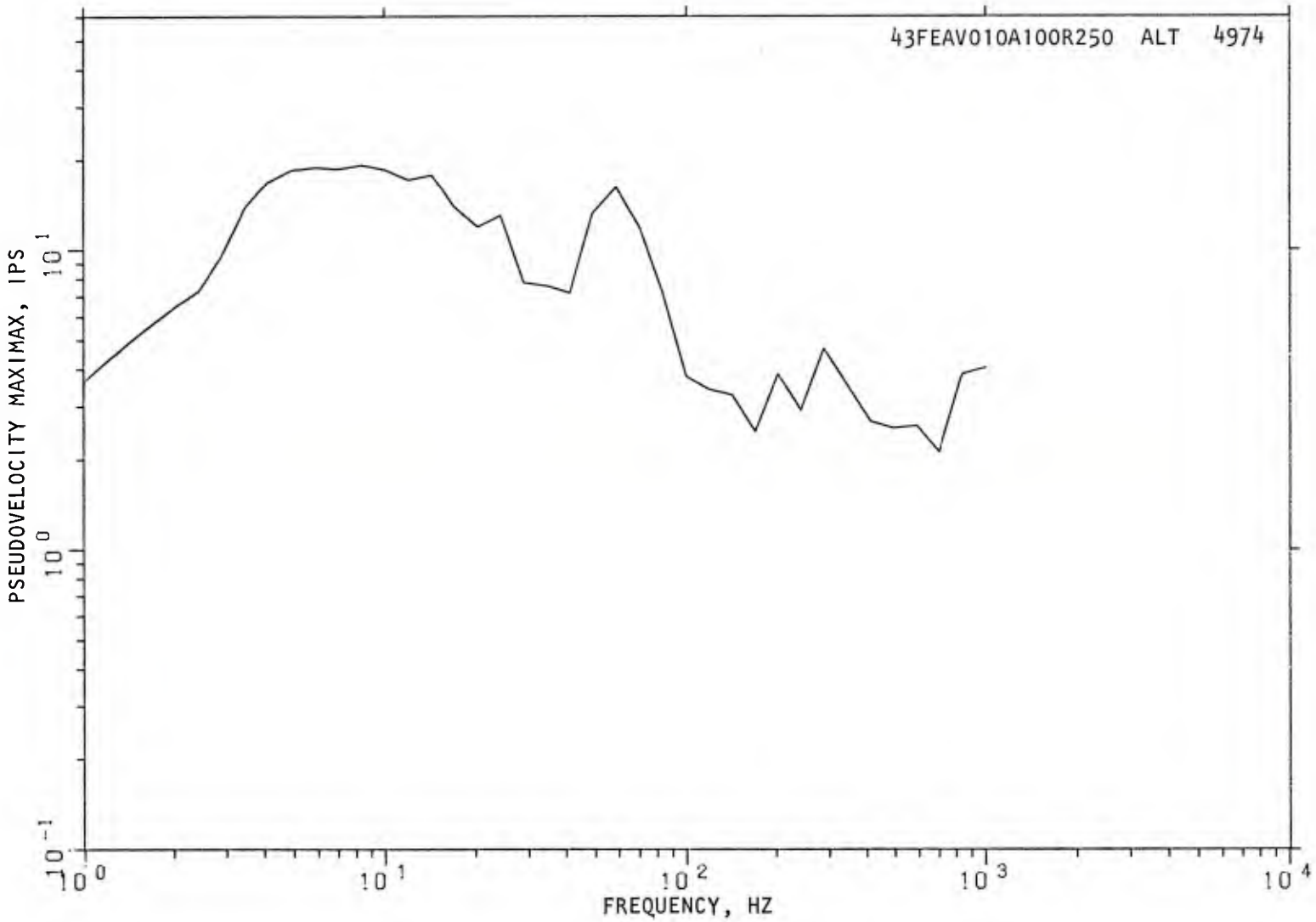
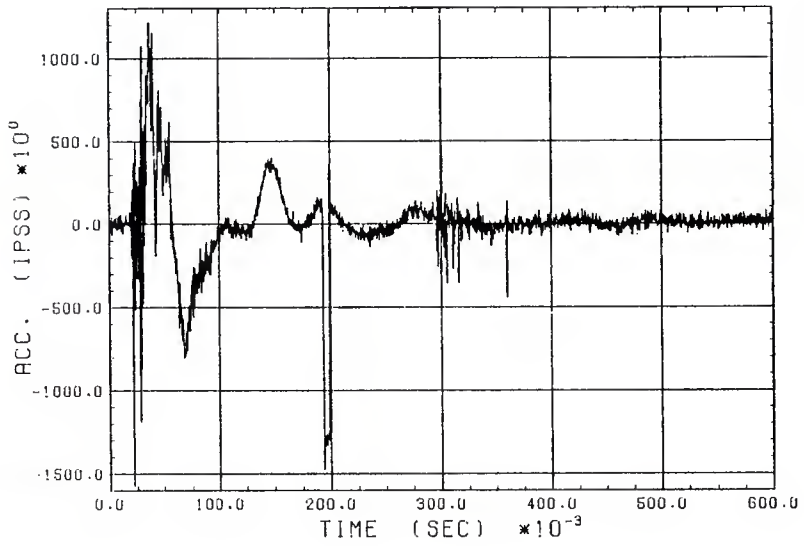


FIGURE C-6. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP ACCELERATION RECORD WITH NO DAMPING AND NO RESIDUAL

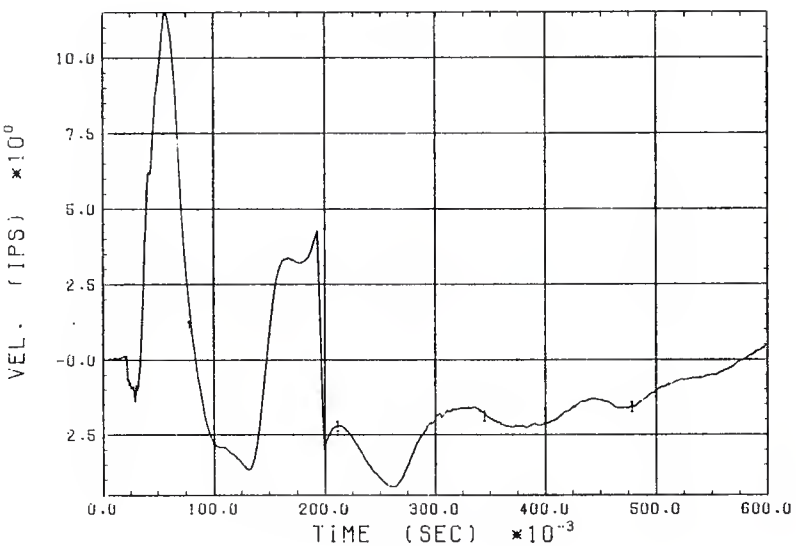
FILE 2924



CURVE 1 PAGE 4
43FEANG10R100R250 A L 250-10-AH-E WES
5.9995E+03 -1.5748E+03 1.2204E+03
0.0000E+00 5.9988E-01 -1.5748E+03 1.2204E+03
0-AH 5-4 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		4963	2924	2924

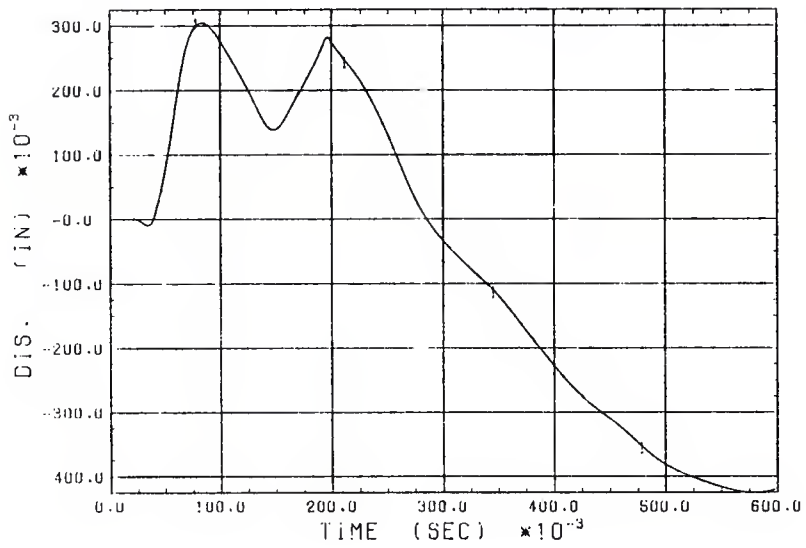
FIGURE C-7. RAW ACCELERATION RECORD FILTERED, TFILLP, TO 2500 HZ AND DECIMATED TO 6000 SAMPLES/SEC



CURVE 1 PAGE 5
43FEAN010A100R250 V LI 250-10-AH-E WES
5.9995E+03 -4.2314E+00 1.1455E+01
0.0000E+00 5.9988E-01 -4.2314E+00 1.1455E+01
0-AH 5-4 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	2924	2924
PINT	0.0000E+00				
			0	2924	2924

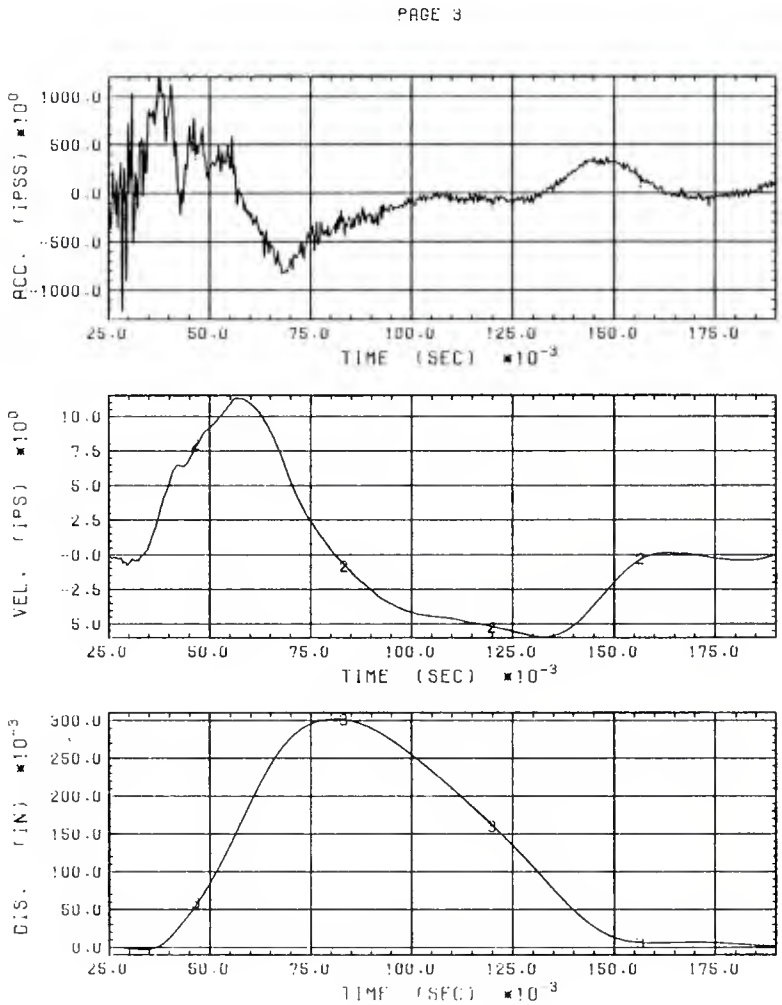
FIGURE C-8. FILTERED ACCELERATION RECORD INTEGRATED, PINT, TO OBTAIN VELOCITY



CURVE 1 PAGE 6
43FEAN010A100R250 D LIT 250--10-AH--E WES
5.9995E+03 -4.2460E-01 3.0480E-01
0.0000E+00 5.9988E-01 -4.2460E-01 3.0480E-01
0--AH 5--4 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	2924	2924
PINT	0.0000E+00				
			0	2924	2924
PINT	0.0000E+00				
			0	2924	2924

FIGURE C-9. FILTERED ACCELERATION RECORD DOUBLE INTEGRATED, PINT AND PINT, TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 3
43FEAN010A100R250 A LT 250-10-AH-E WES
5.9995E+03 -1.2167E+03 1.1922E+03
2.5002E-02 1.8985E-01 -1.2167E+03 1.1922E+03
0-AH S-4 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		4975	4963	2924
DETN	0.0000E+00	0.0000E+00	0.0000E+00		
			4975	4963	2924

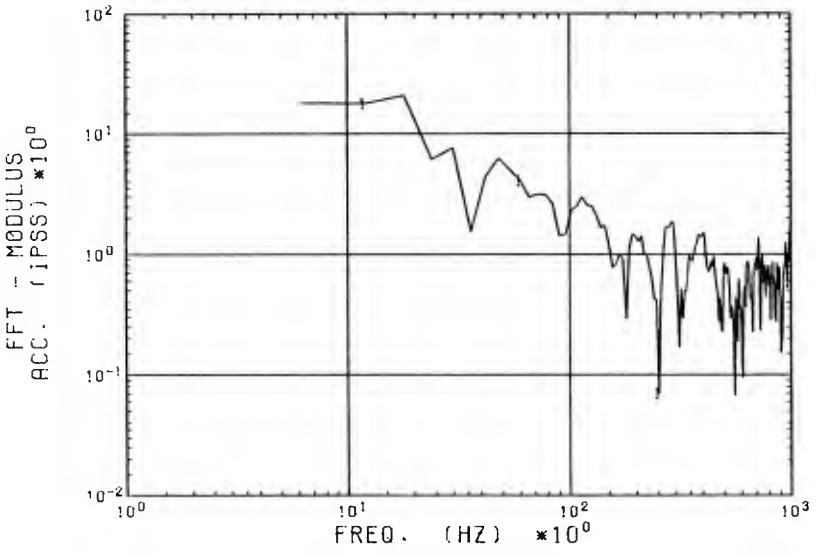
CURVE 2 PAGE 3
43FEAN010A100R250 V LTI 250-10-AH-E WES
5.9995E+03 -5.9429E+00 1.1315E+01
2.5002E-02 1.8985E-01 -5.9429E+00 1.1315E+01
0-AH S-4 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4963	2924
DETN	0.0000E+00	0.0000E+00	0.0000E+00		
			0	4963	2924
PINT	0.0000E+00				
			0	4963	2924

CURVE 3 PAGE 3
43FEAN010A100R250 D LTI 250-10-AH-E WES
5.9995E+03 -2.9220E-03 3.0217E-01
2.5002E-02 1.8985E-01 -2.9220E-03 3.0217E-01
0-AH S-4 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4963	2924
DETN	0.0000E+00	0.0000E+00	0.0000E+00		
			0	4963	2924
PINT	0.0000E+00				
			0	4963	2924
PINT	0.0000E+00				
			0	4963	2924

FIGURE C-10. FILTERED ACCELERATION RECORD DETRENDED, DETN, WITH AN OFFSET LEAST SQUARES FIT TO DATA FROM TIME BETWEEN 0.025 AND 0.190 SECONDS, INTEGRATED, PINT, TO OBTAIN VELOCITY, AND DOUBLE INTEGRATED, PINT AND PINT, TO OBTAIN DISPLACEMENT. PRESHOCK ARRIVAL NOISE HAS BEEN REMOVED



CURVE 1 PAGE 4
43FEANO10A100R250 FA LTAF 250-10-AH-E WES
1.6668E-01 6.8093E-02 2.074DE+01
5.9995E+00 9.9592E+02 6.8093E-02 2.074DE+01
O-AH S-4 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4963	2924
DETN	0.0000E+00	0.0000E+00	0.0000E+00		
			0	4963	2924
FOUR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4963	2924
CPOL	0.0000E+00				
			0	4963	2924

FIGURE C-11. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP ACCELERATION RECORD WITH REAR 10% OF RECORD COSINE TAPERED

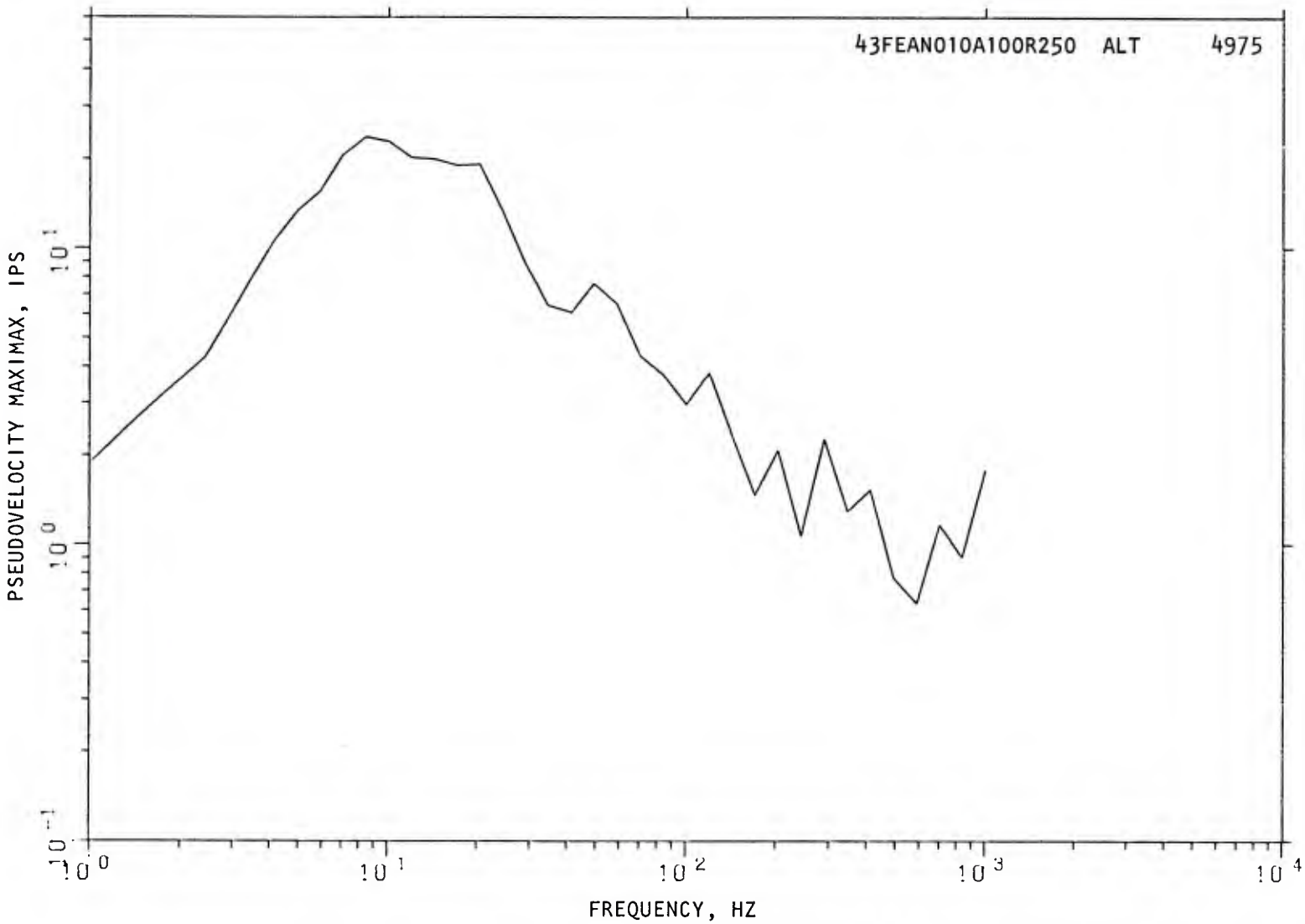
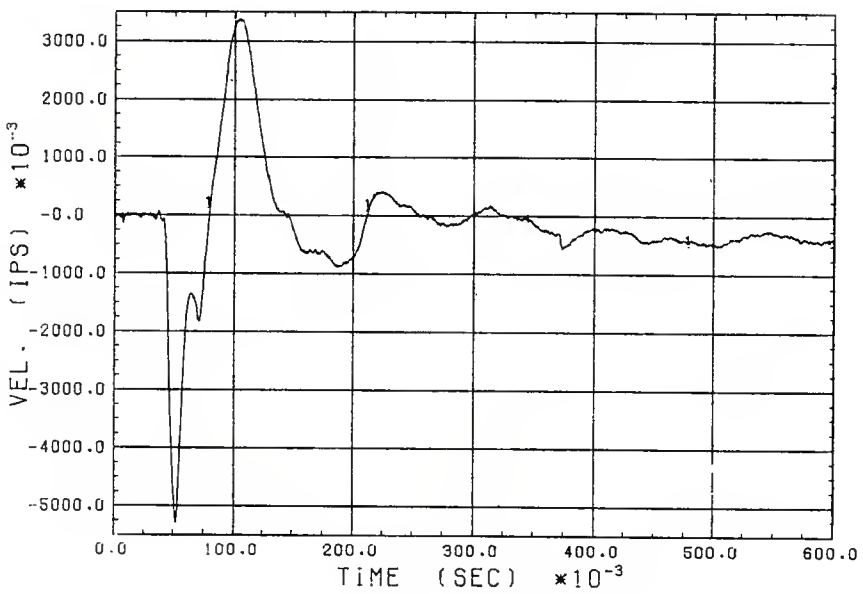


FIGURE C-12. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP ACCELERATION RECORD WITH NO DAMPING AND NO RESIDUAL

FILE 3061

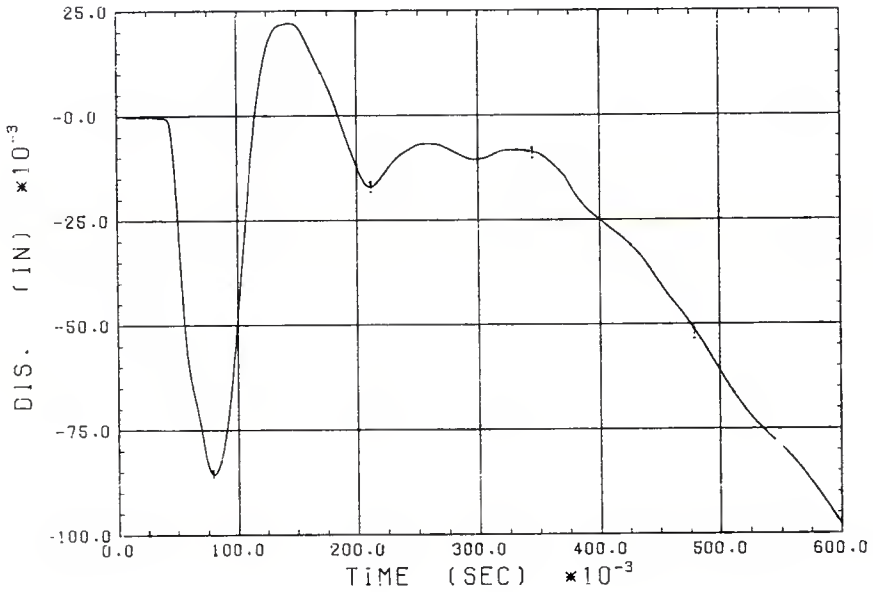
PAGE 13



CURVE 1 PAGE 13
43FEVV010A100R250 V L 250-10-UV-E WES
6.0002E+03 -5.3019E+00 3.3920E+00
0.0000E+00 5.9981E-01 -5.3019E+00 3.3920E+00
0-UV 13-3 MIN ROCK-EAST
TFILLP 0.0000E+00 2.0000E+00 2.5000E-03 0.0000E-00 6.0000E-00
0.0000E+00 4966 3061 3061

FIGURE C-13. RAW VELOCITY RECORD FILTERED, TFILLP, TO 2500 HZ AND DECIMATED TO 6000 SAMPLES/SECOND

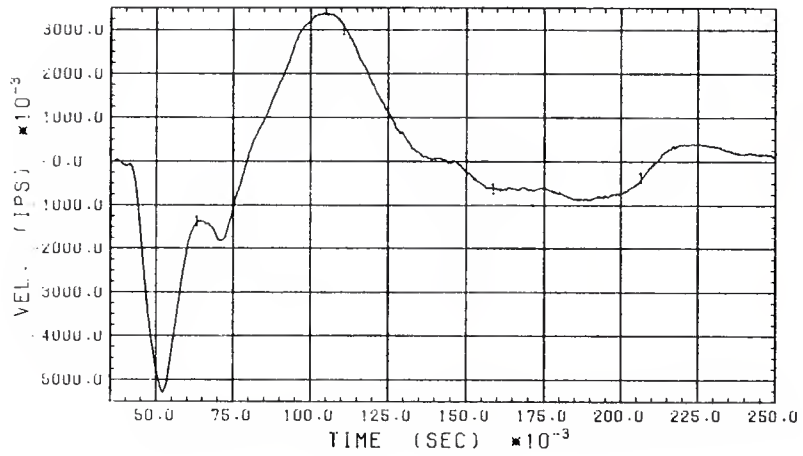
PAGE 14



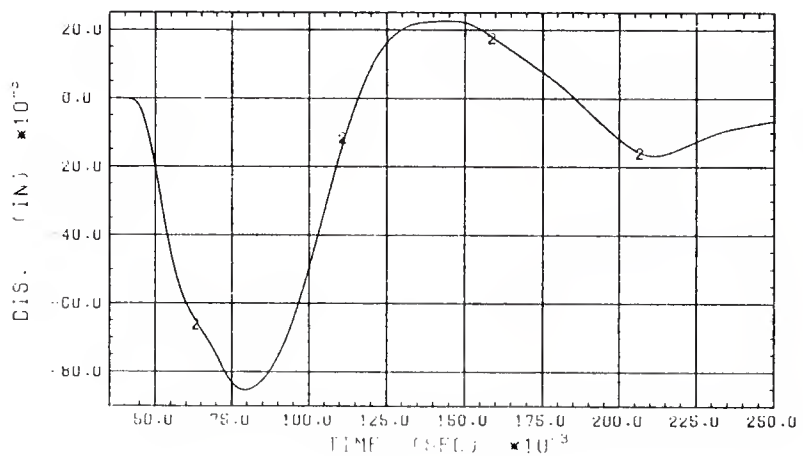
CURVE 1 PAGE 14
43FEVV01OR!00R250 D LI 250-10-UV-E WES
6.0002E+03 -9.7916E-02 2.2015E-02
0.0000E+00 5.9981E-01 -9.7916E-02 2.2015E-02
0-UV 13-3 MIN ROCK-EAST

TFILLP	0.0000E+00	2.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	3061	3061
PINT	0.0000E+00				
			0	3061	3061

FIGURE C-14. FILTERED VELOCITY RECORD INTEGRATED, PINT, TO OBTAIN DISPLACEMENT

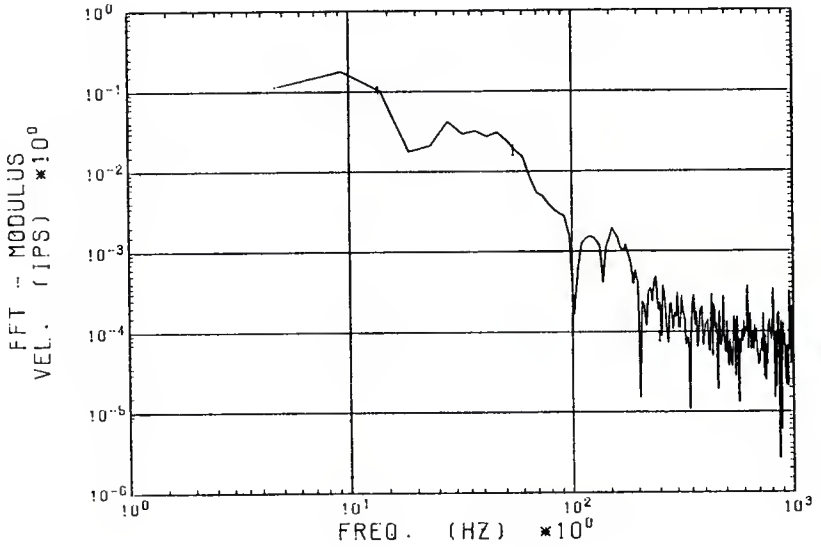



```
CURVE 1     PAGE 9
43FEVV010A100R250    V L                  250-10-UV-E        WES
6.0002E+03                          -5.3019E+00       3.3920E+00
3.5165E-02       2.4999E-01         -5.3019E+00       3.3920E+00
0-UV 13-3 MIN ROCK-EAST
 TFILLP    0.0000E+00  2.0000E+00  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                        0        4966        3061
```




```
CURVE 2     PAGE 9
43FEVV010A100R250    D LI                 250-10-UV-E        WES
6.0002E+03                          -8.5326E-02       2.2512E-02
3.5165E-02       2.4999E-01         -8.5326E-02       2.2512E-02
0-UV 13-3 MIN ROCK-EAST
 TFILLP    0.0000E+00  2.0000E+00  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                        0        4966        3061
 PINT      0.0000E+00
                                             0        4966        3061
```

FIGURE C-15. FILTERED VELOCITY RECORD WITH PRESHOCK ARRIVAL NOISE REMOVED AND INTEGRATED TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 10
43FEVV010A100R250 FV LAF 250--10-UV-E WES
2.1599E-01 2.6504E-06 1.7780E-01
4.6298E+00 9.9541E+02 2.6504E-06 1.7780E-01
0-UV 13-3 MIN ROCK-EAST

TFILLP	0.0000E+00	2.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4966	3061
FOUR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4966	3061
CPOL	0.0000E+00				
			0	4966	3061

FIGURE C-16. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP VELOCITY RECORD WITH REAR 10% OF RECORD COSINE TAPERED

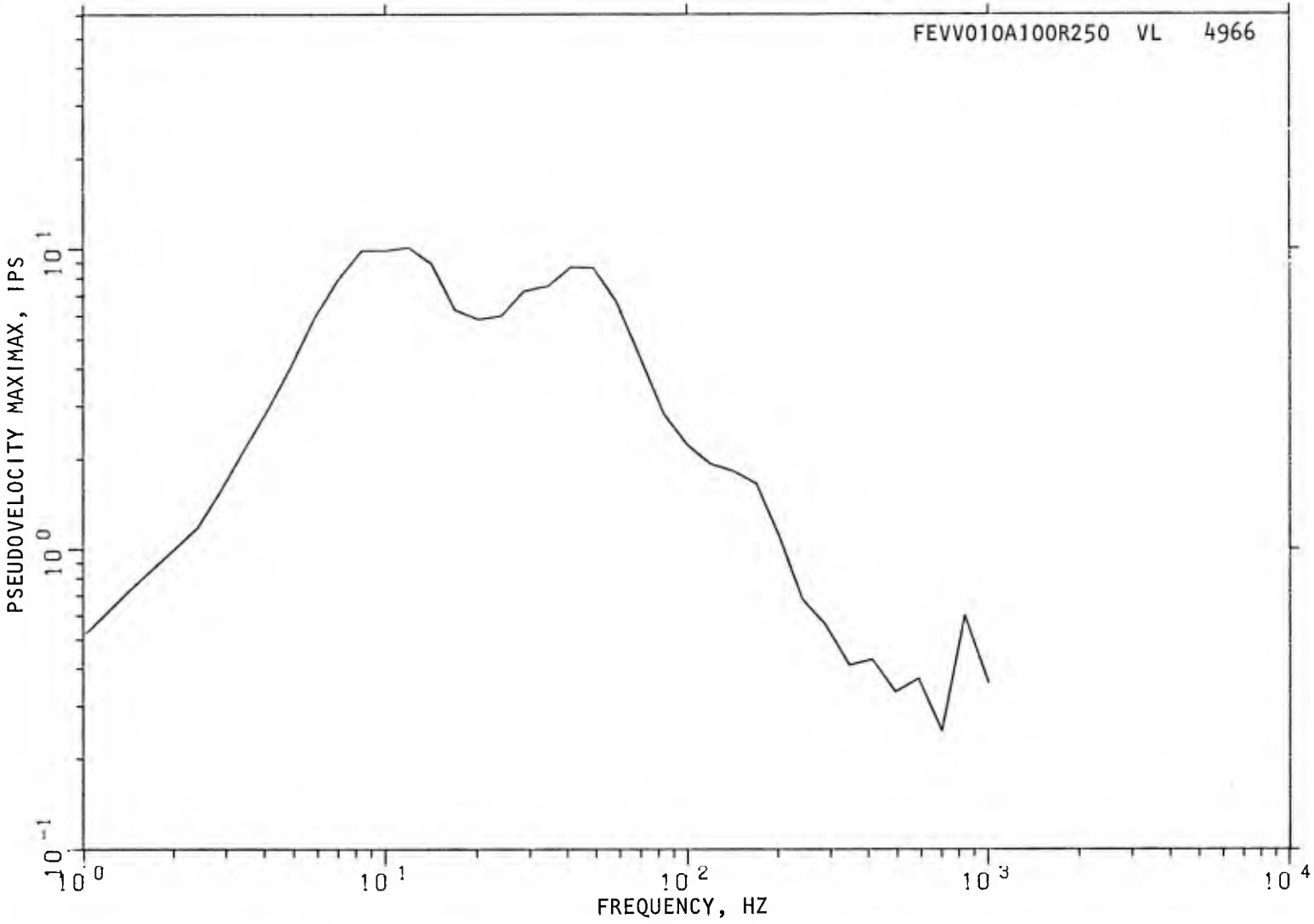
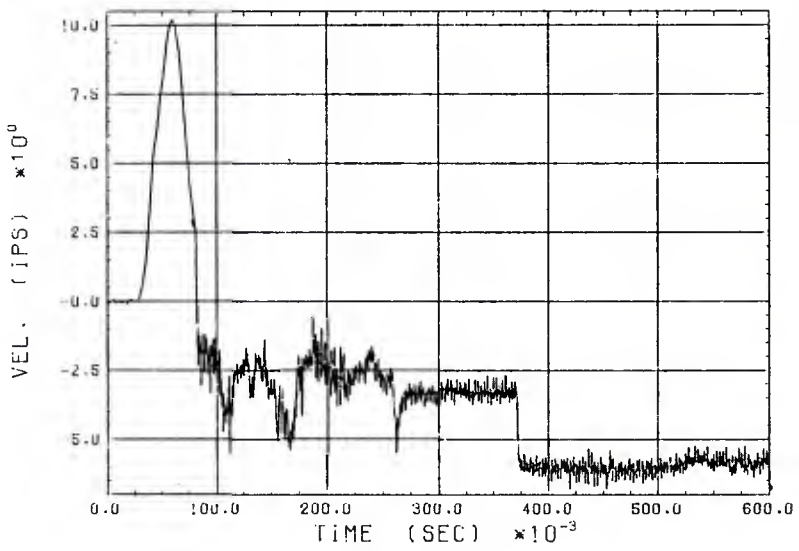


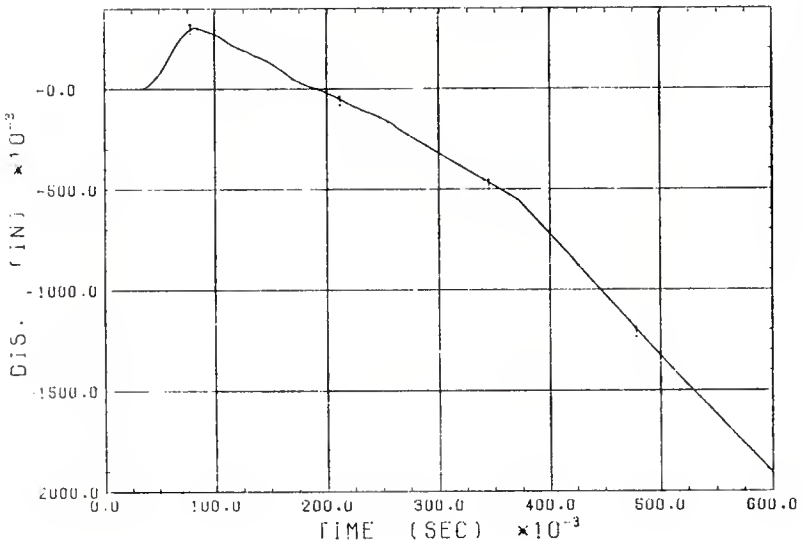
FIGURE C-17. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP VELOCITY RECORD WITH NO DAMPING AND NO RESIDUAL

FILE 3062



CURVE 1 PAGE 15
43FEVN010A100R250 V L 250-10--UH-E WES
6.0002E+03 -6.7763E+00 1.0195E+01
0.0000E+00 5.9981E-01 -6.7763E+00 1.0195E+01
0-UH 13-4 MIN ROCK-EAST
TFILLP 0.0000E+00 2.0000E+00 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 4967 3062 3062

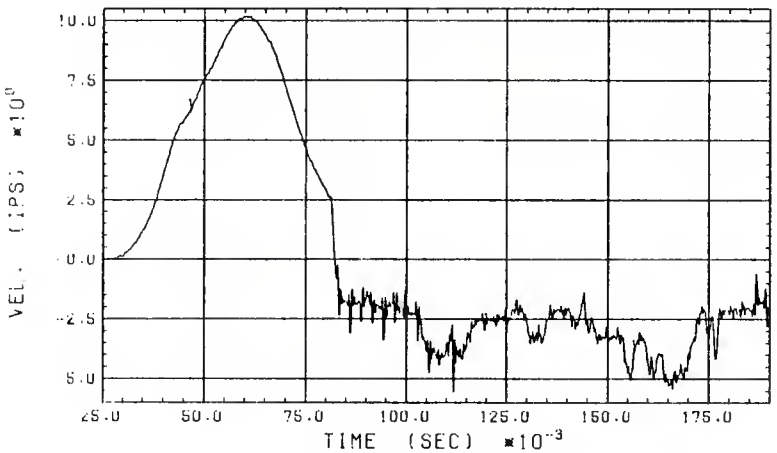
FIGURE C-18. RAW VELOCITY RECORD FILTERED, TFILLP, TO 2500 HZ AND DECIMATED TO 6000 SAMPLES/SEC



CURVE 1 PAGE 16
43FEVN010A1D0R250 D L I 250-10-UH-E WES
6.0002E+03 -1.9122E+00 3.0701E-01
0.0000E+00 5.9981E-01 -1.9122E+00 3.0701E-01
U-UH 13-4 MIN ROCK-EAST

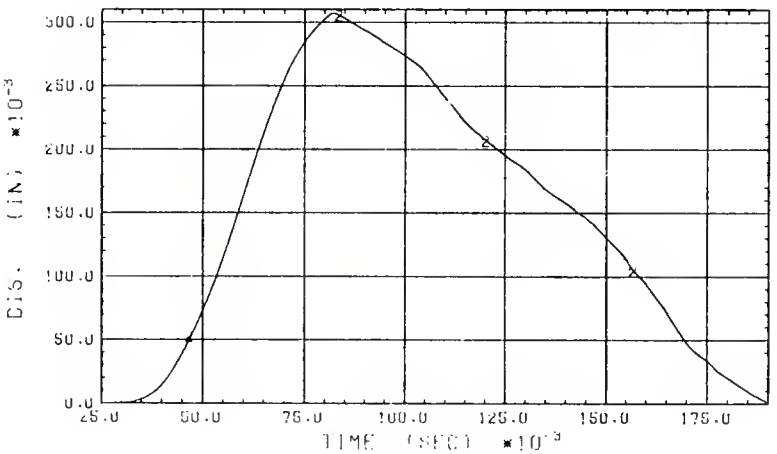
TFILLP	0.0000E+00	2.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	3062	3062
PINT	0.0000E+00				
			0	3062	3062

FIGURE C-19. FILTERED VELOCITY RECORD INTEGRATED, PINT, TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 13
43FEVN01DA100R250 V L 250-10-UH-E WES
6.0002E+03 -5.5412E+00 1.0195E+01
2.5166E-02 1.8999E-01 -5.5412E+00 1.0195E+01
0-UH 13-4 MIN ROCK-EAST

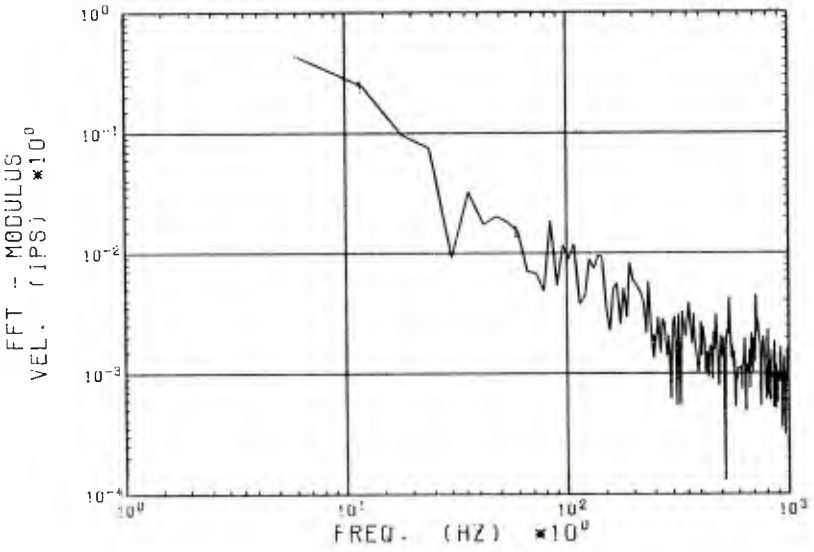
TFILLP	0.0000E+00	2.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4967	3062



CURVE 2 PAGE 13
43FEVN01DA100R250 D LI 250-10-UH-E WES
6.0002E+03 -2.1998E-05 3.0697E-01
2.5166E-02 1.8999E-01 -2.1998E-05 3.0697E-01
0-UH 13-4 MIN ROCK-EAST

TFILLP	0.0000E+00	2.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4967	3062
PINT	0.0000E+00				
			0	4967	3062

FIGURE C-20. FILTERED VELOCITY RECORD WITH PRESHOCK ARRIVAL NOISE REMOVED AND INTEGRATED TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 14
43FEVN010A100R250 FV I.AF 250--10-UH-E WES
1.6666E-01 1.3063E-04 4.3608E-01
6.0002E+00 9.9604E+02 1.3063E-04 4.3608E-01
0--UH 13--4 MIN ROCK-EAST

TFILLP	0.0000E+00	2.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4967	3062
FOUR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4967	3062
CPOL	0.0000E+00				
			0	4967	3062

FIGURE C-21. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP VELOCITY RECORD WITH REAR 10% OF RECORD COSINE TAPERED

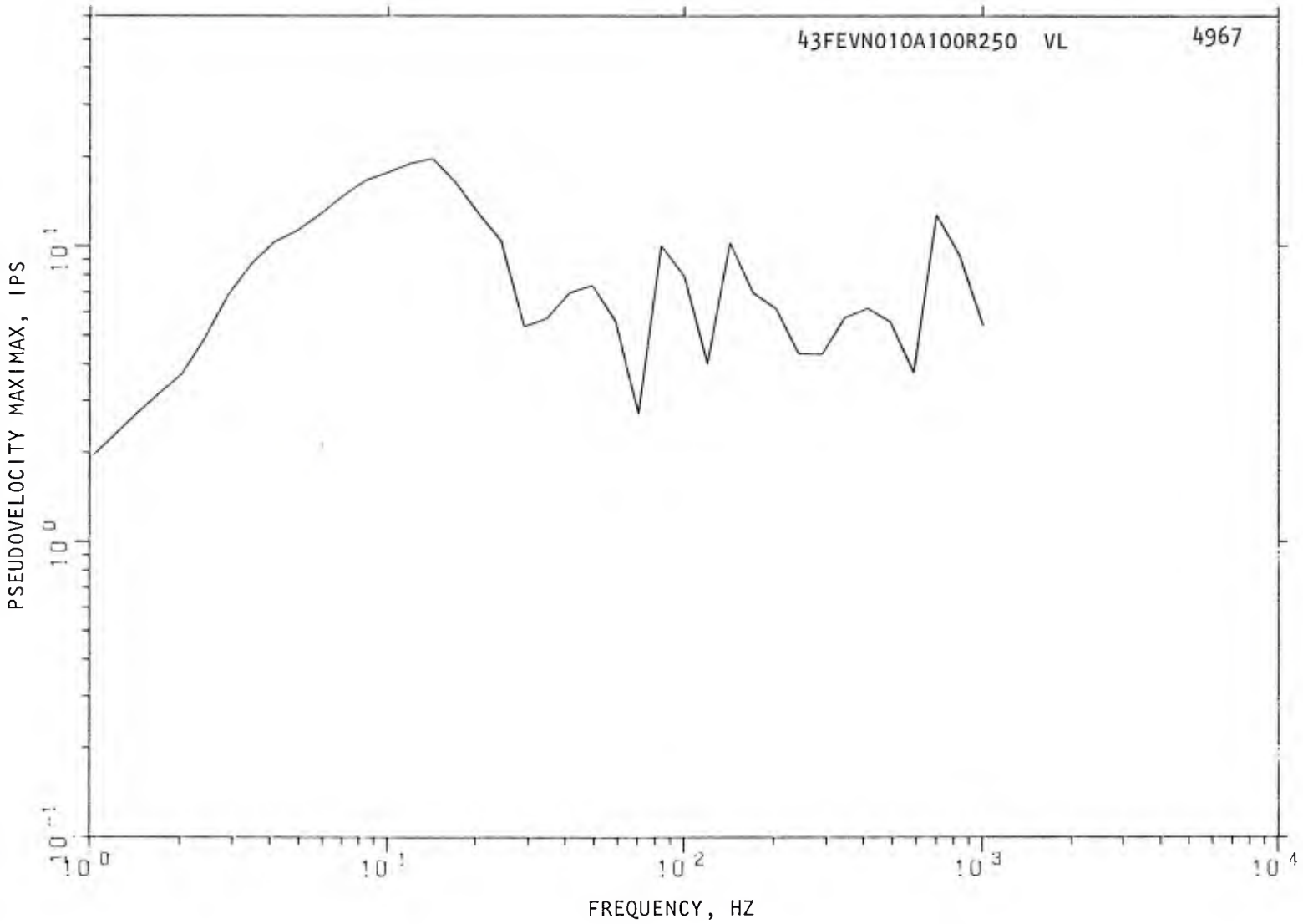
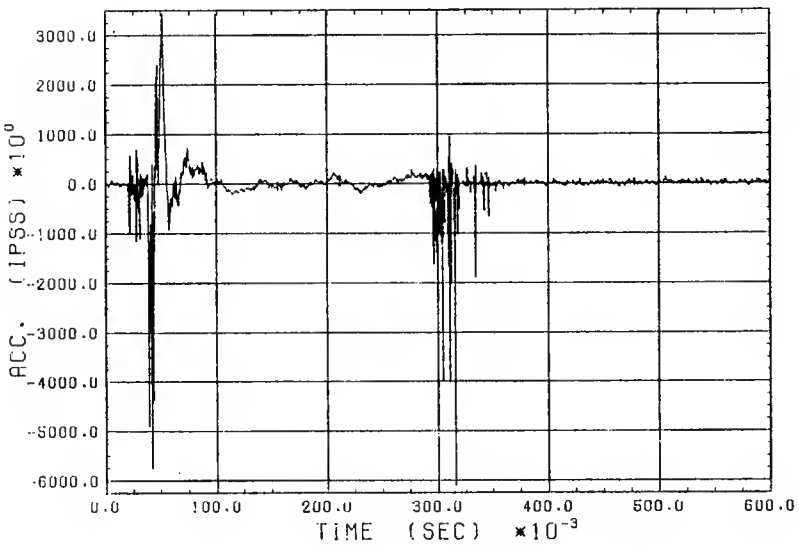


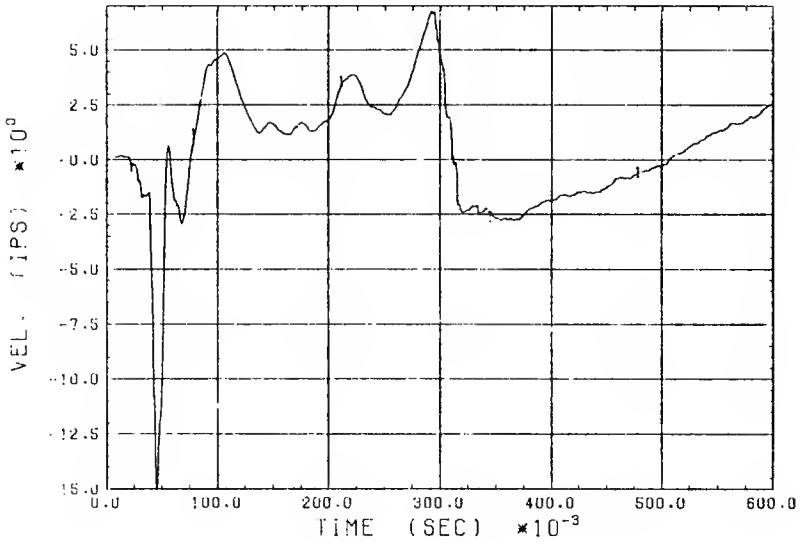
FIGURE C-22. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP VELOCITY RECORD WITH NO DAMPING AND NO RESIDUAL

FILE 2919



CURVE 1 PAGE 7
43FEAV002A100R250 A L 250-2-AV--E WES
5.9995E+03 -6.0964E+03 3.4433E+03
0.0000E+00 5.9988E-01 -6.0964E+03 3.4433E+03
--AV 6-11 MIN ROCK-EAST
TFILLP 0.0000E+00 4.0000E+00 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 4964 2919 2919

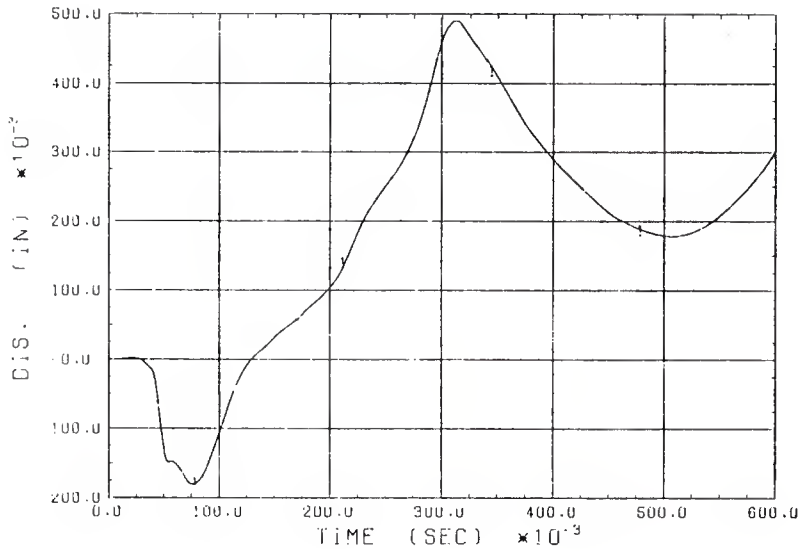
FIGURE C-23. RAW ACCELERATION RECORD FILTERED, TFILLP, TO 2500 HZ AND DECIMATED TO 6000 SAMPLES/SEC



CURVE 1 PAGE 8
43FEAV002A100R250 V LI 250--2--AV--E WES
5.9995E+03 -1.4966E+01 6.8006E+00
0.0000E+00 5.9988E-01 -1.4966E+01 6.8006E+00
AV 6-11 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	2919	2919
PINT	0.0000E+00				
			0	2919	2919

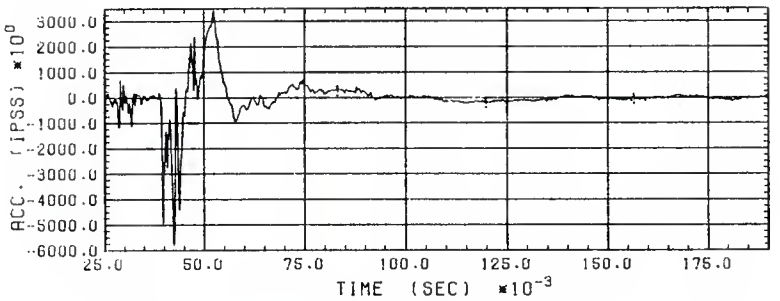
FIGURE C-24. FILTERED ACCELERATION RECORD INTEGRATED, PINT, TO OBTAIN VELOCITY



CURVE 1 PAGE 9
43FEAV002A100R250 D LI1 250--2-AV-E WES
5.9995E+03 --1.8084E-01 4.9031E-01
0.0000E+00 5.9988E-01 --1.8084E-01 4.9031E-01
--AV 6-11 MIN ROCK-EAST

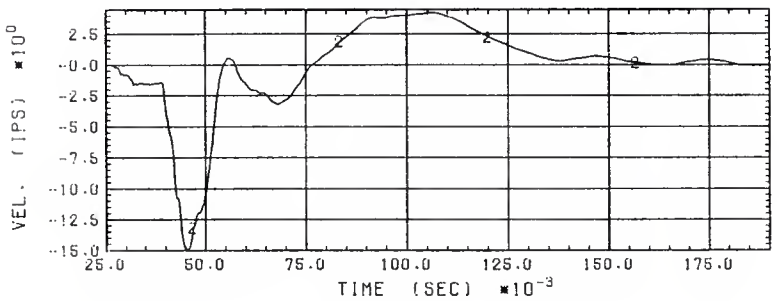
TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	2919	2919
PINT	0.0000E+00				
			0	2919	2919
PINT	0.0000E+00				
			0	2919	2919

FIGURE C-25. FILTERED ACCELERATION RECORD DOUBLE INTEGRATED, PINT AND PINT, TO OBTAIN DISPLACEMENT



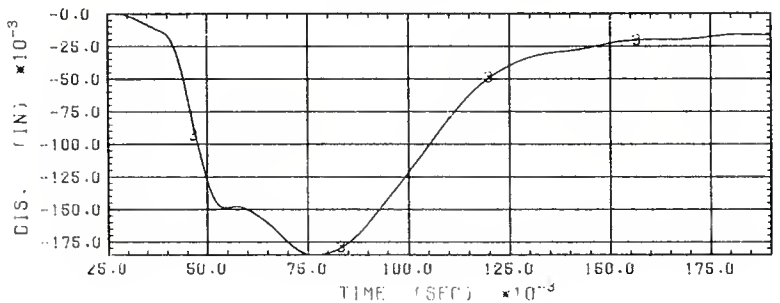
CURVE 1 PAGE 5
43FEAV002A100R250 A LT 250-2-AV-E WES
5.9995E+03 -5.7783E+03 3.4333E+03
2.5002E-02 1.8985E-01 -5.7783E+03 3.4333E+03
-AV 6-11 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		4976	4964	2919
DETN	0.0000E+00	0.0000E+00	0.0000E+00		
			4976	4964	2919



CURVE 2 PAGE 5
43FEAV002A100R250 V LTI 250-2-AV-E WES
5.9995E+03 -1.4966E+01 4.2685E+00
2.5002E-02 1.8985E-01 -1.4966E+01 4.2685E+00
-AV 6-11 MIN ROCK-EAST

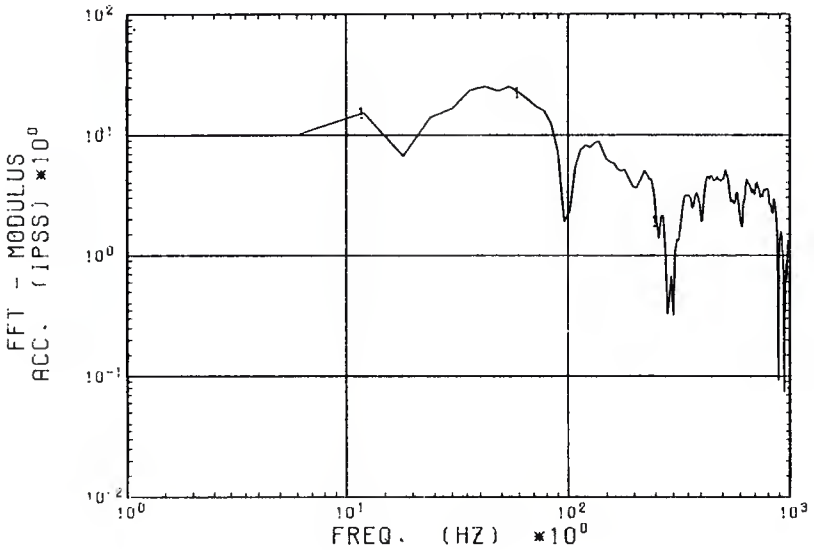
TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4964	2919
DETN	0.0000E+00	0.0000E+00	0.0000E+00		
			0	4964	2919
PINT	0.0000E+00				
			0	4964	2919



CURVE 3 PAGE 5
43FEAV002A100R250 D LTII 250-2-AV-E WES
5.9995E+03 -1.8498E-01 -2.1311E-06
2.5002E-02 1.8985E-01 -1.8498E-01 -2.1311E-06
-AV 6-11 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4964	2919
DETN	0.0000E+00	0.0000E+00	0.0000E+00		
			0	4964	2919
PINT	0.0000E+00				
			0	4964	2919
PINT	0.0000E+00				
			0	4964	2919

FIGURE C-26. FILTERED ACCELERATION RECORD DETRENDED, DETN, WITH AN OFFSET LEAST SQUARES FIT TO DATA FROM TIME BETWEEN 0.025 AND 0.190 SECONDS, INTEGRATED, PINT, TO OBTAIN VELOCITY, AND DOUBLE INTEGRATED, PINT AND PINT, TO OBTAIN DISPLACEMENT. PRESHOCK ARRIVAL NOISE HAS BEEN REMOVED



CURVE 1 PAGE 6
43FEAV002A100R250 FR LTAF 250-2-AV-E WES
1.6668E-01 7.4593E-02 2.5293E+01
5.9995E+00 9.9592E+02 7.4593E-02 2.5293E+01
-AV 6-11 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4964	2919
DETN	0.0000E+00	0.0000E+00	0.0000E+00		
			0	4964	2919
FOUR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4964	2919
CPOL	0.0000E+00				
			0	4964	2919

FIGURE C-27. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP ACCELERATION RECORD WITH REAR 10% OF RECORD COSINE TAPERED

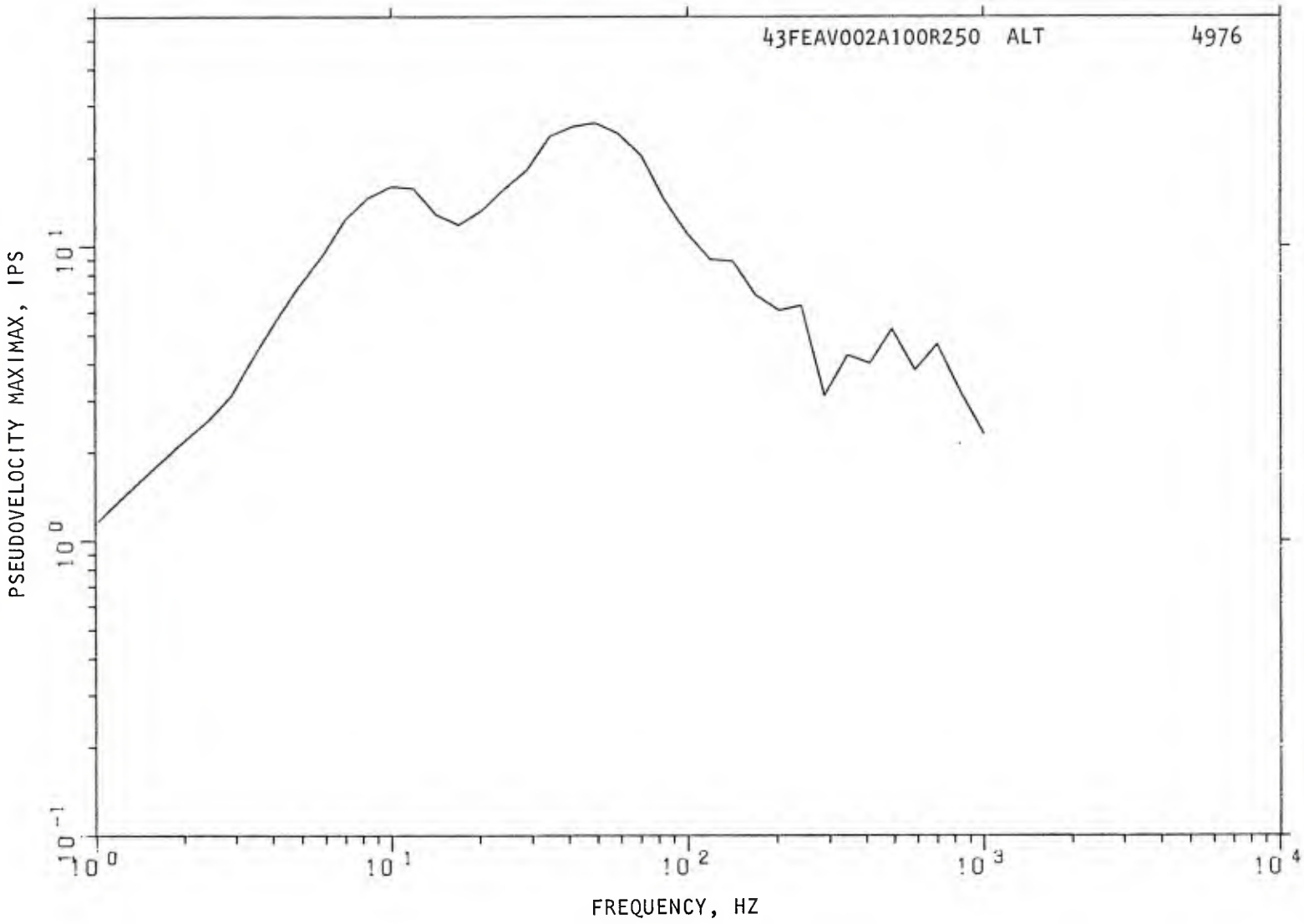
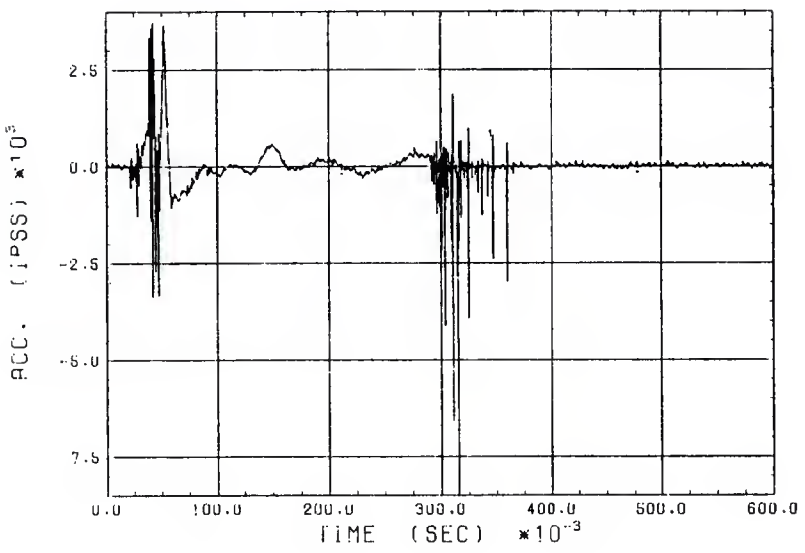


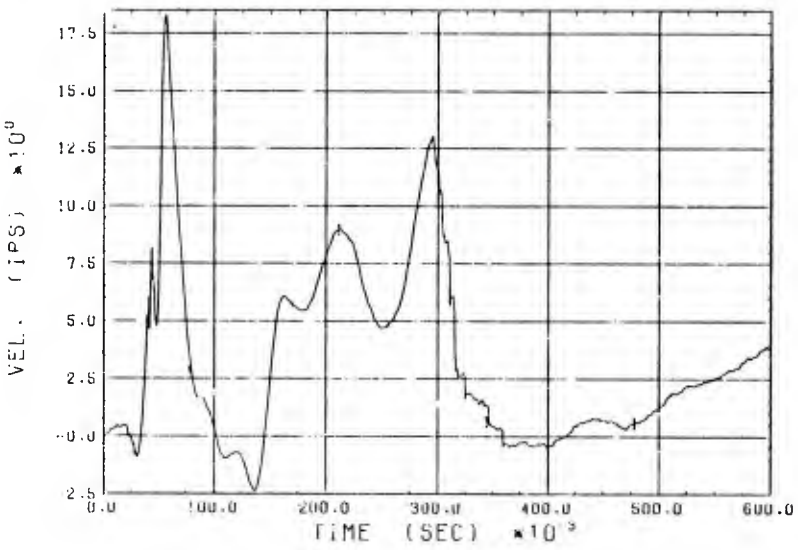
FIGURE C-28. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP ACCELERATION RECORD WITH NO DAMPING AND NO RESIDUAL

FILE 2920



CURVE 1 PAGE 10
43FEAN002A1OOR250 A L 250--2--AH-E WES
5.9995E+03 -8.5011E+03 3.7262E+03
0.0000E+00 5.9988E-01 -8.5011E+03 3.7262E+03
--AH 6-12 MIN ROCK-EAST
TFILLP 0.0000E+00 4.0000E+00 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 4965 2920 2920

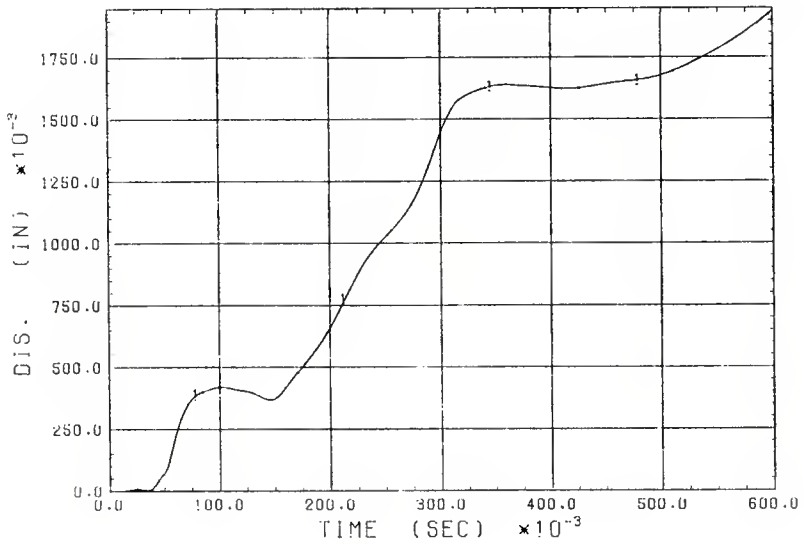
FIGURE C-29. RAW ACCELERATION RECORD FILTERED, TFILLP, TO 2500 HZ AND DECIMATED TO 6000 SAMPLES/SEC



CURVE 1 PAGE 11
43FEANOO2A!OOR250 V LI 250--2-AH-E WES
5.9995E+03 --2.3888E+00 1.8298E+01
0.0000E+00 5.9988E-01 --2.3888E+00 1.8298E+01
--AH 6-12 MIN ROCK-EAST

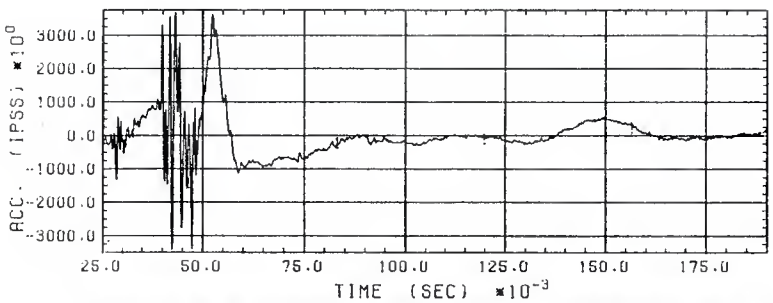
IFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00	
	0.0000E+00			0	2920	2920
PINT	0.0000E+00					
				0	2920	2920

FIGURE C-30. FILTERED ACCELERATION RECORD INTEGRATED, PINT, TO OBTAIN VELOCITY



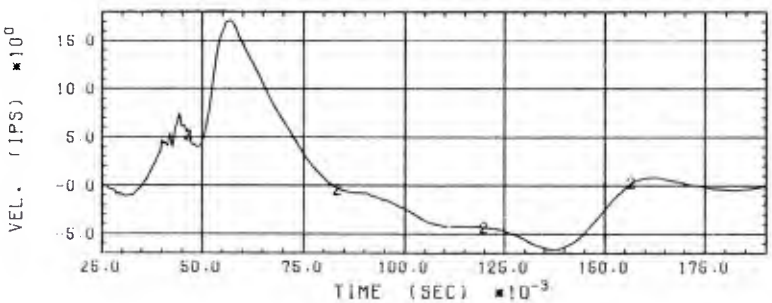

```
CURVE 1     PAGE 12
43FEAN002A100R250    D LII                250-2-AH-E          WES
5.9995E+03                          3.7059E-10      1.9401E+00
0.0000E+00      5.9988E-01          3.7059E-10      1.9401E+00
-AH 6-12 MIN ROCK-EAST
 IFILLP    0.0000E+00  4.0000E+00  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                      0        2920        2920
 PINT      0.0000E+00
                                           0        2920        2920
 PINT      0.0000E+00
                                           0        2920        2920
```

FIGURE C-31. FILTERED ACCELERATION RECORD DOUBLE INTEGRATED, PINT AND PINT, TO OBTAIN DISPLACEMENT



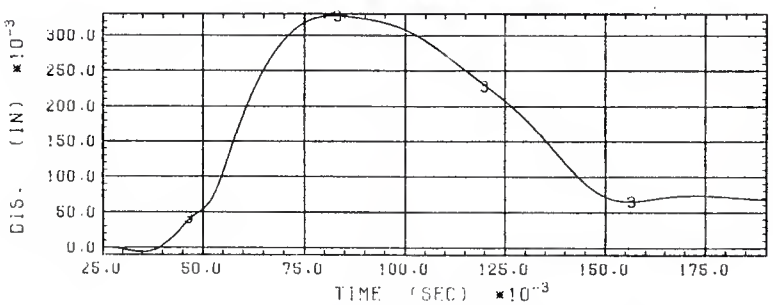
CURVE 1 PAGE 7
43FEAN002A100R250 A LT 250-2-AH-E WES
5.9995E+03 -3.4108E+03 3.6879E+03
2.5002E-02 1.8985E-01 -3.4108E+03 3.6879E+03
-AH 6-12 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		4977	4965	2920
DETN	0.0000E+00	0.0000E+00	0.0000E+00		
			4977	4965	2920



CURVE 2 PAGE 7
43FEAN002A100R250 V LTI 250-2-AH-E WES
5.9995E+03 -6.6387E+00 1.7120E+01
2.5002E-02 1.8985E-01 -6.6387E+00 1.7120E+01
-AH 6-12 MIN ROCK-EAST

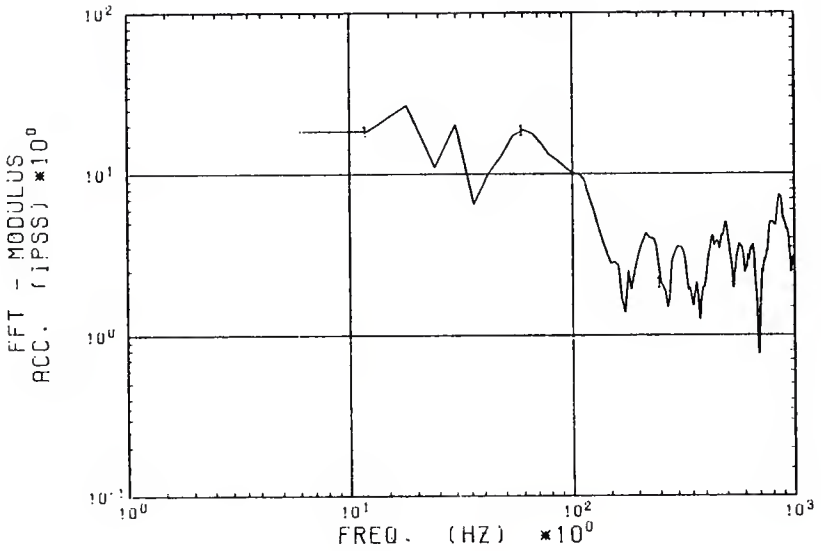
TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4965	2920
DETN	0.0000E+00	0.0000E+00	0.0000E+00		
			0	4965	2920
PINT	0.0000E+00				
			0	4965	2920



CURVE 3 PAGE 7
43FEAN002A100R250 D LTI1 250-2-AH-E WES
5.9995E+03 -6.0582E-03 3.2770E-01
2.5002E-02 1.8985E-01 -6.0582E-03 3.2770E-01
-AH 6-12 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4965	2920
DETN	0.0000E+00	0.0000E+00	0.0000E+00		
			0	4965	2920
PINT	0.0000E+00				
			0	4965	2920
PINT	0.0000E+00				
			0	4965	2920

FIGURE C-32. FILTERED ACCELERATION RECORD DETRENDED, DETN, WITH AN OFFSET LEAST SQUARES FIT TO DATA FROM TIME BETWEEN 0.025 AND 0.190 SECONDS, INTEGRATED, PINT, TO OBTAIN VELOCITY, AND DOUBLE INTEGRATED, PINT AND PINT, TO OBTAIN DISPLACEMENT. PRESHOCK ARRIVAL NOISE HAS BEEN REMOVED



CURVE 1 PAGE 8
43FEAN002A100R250 FA LTAF 250-2-AH-E WES
1.6668E-01 7.6473E-01 2.6784E+01
5.9995E+00 9.9592E+02 7.6473E-01 2.6784E+01
-AH 6-12 MIN ROCK-EAST

TFILLP	0.0000E+00	4.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00	
	0.0000E+00		0	4965	2920	
DETN	0.0000E+00	0.0000E+00	0.0000E+00			
			0	4965	2920	
F0UR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
			0	4965	2920	
CP0L	0.0000E+00					
			0	4965	2920	

FIGURE C-33. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP ACCELERATION RECORD WITH REAR 10% OF RECORD COSINE TAPERED

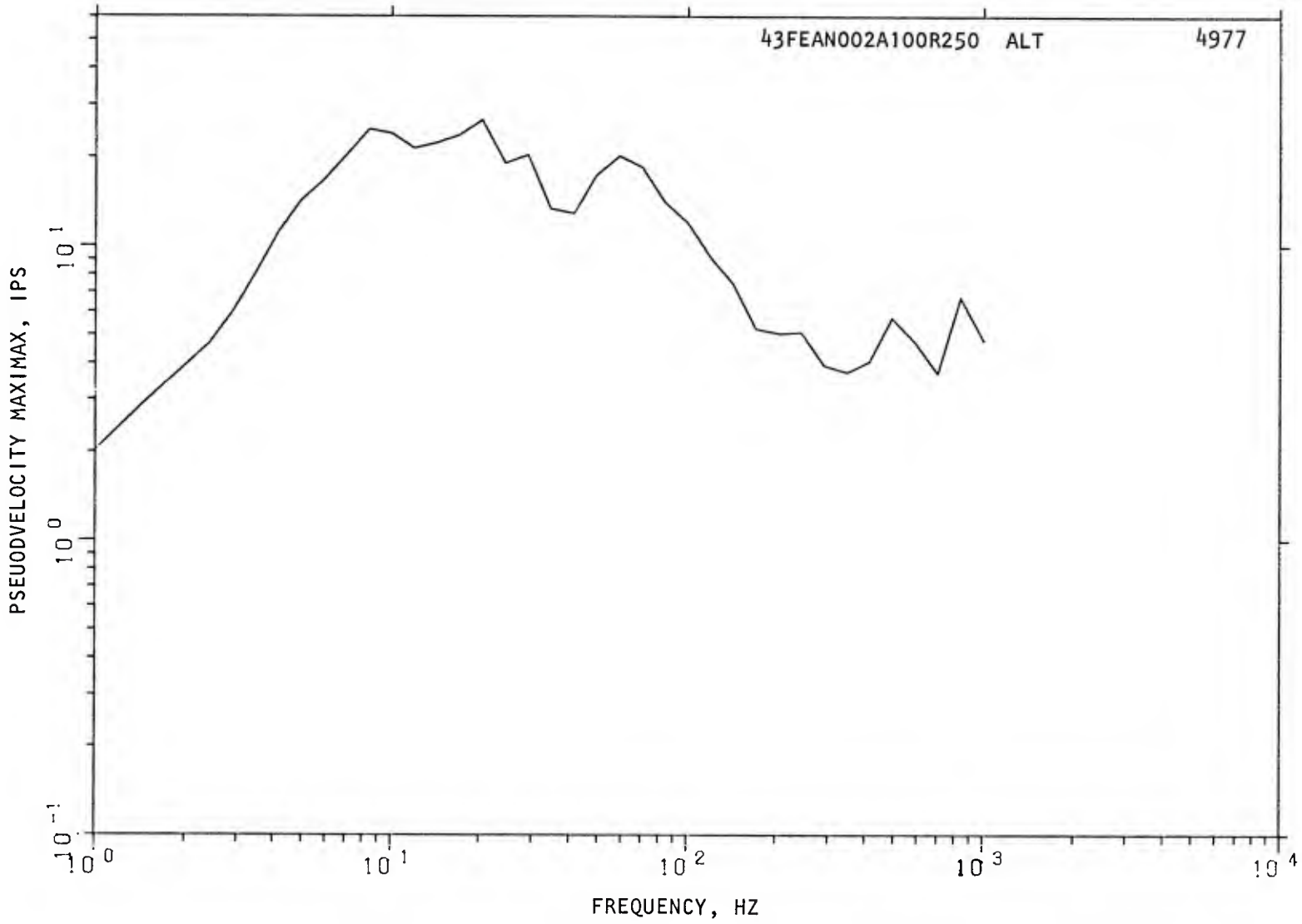
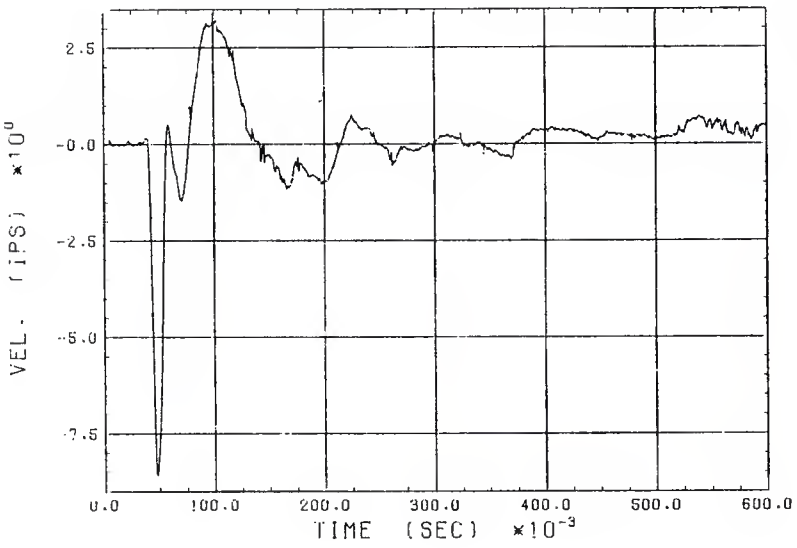


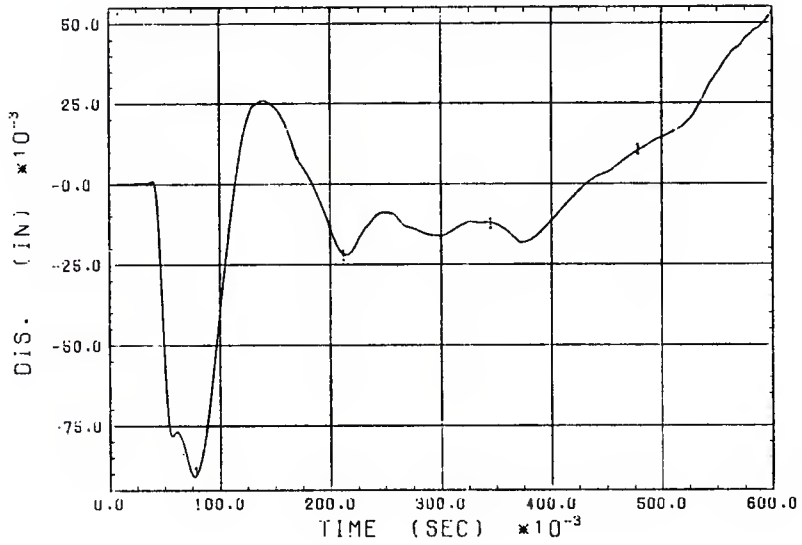
FIGURE C-34. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP ACCELERATION RECORD WITH NO DAMPING AND NO RESIDUAL

FILE 3059



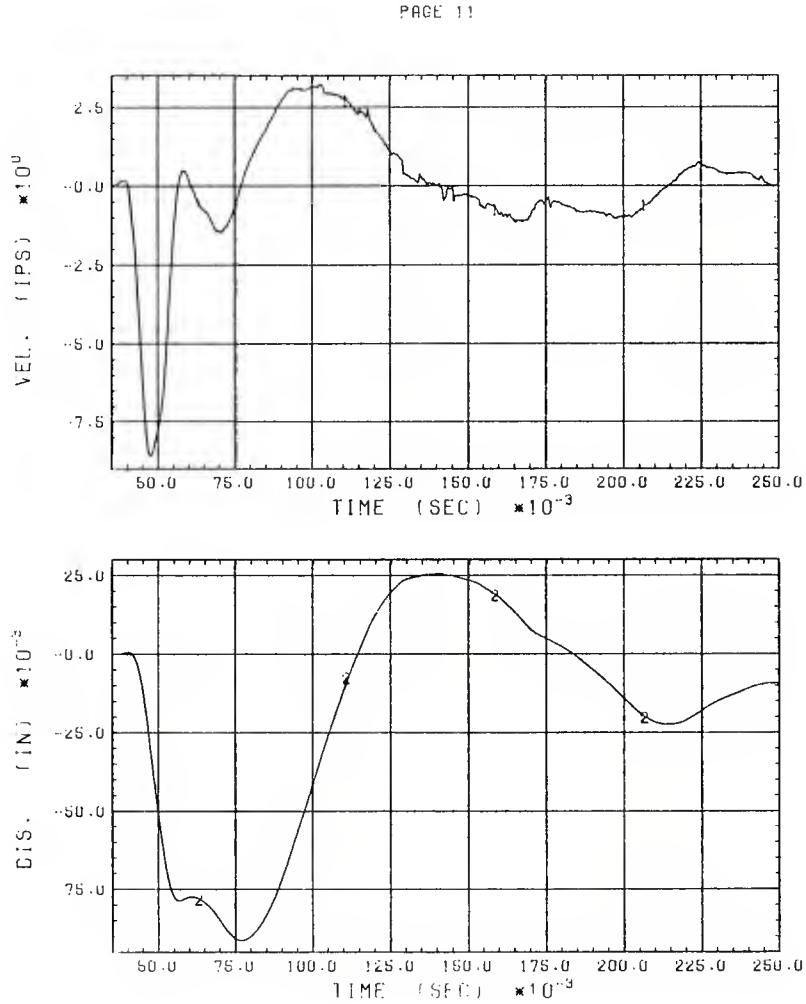
CURVE 1 PAGE 17
43FEVV002A!00R250 V L 250-2-UV --E WES
6.0002E+03 -8.5990E+00 3.2330E+00
0.0000E+00 5.9981E-01 -8.5990E+00 3.2330E+00
--UV 13-1 MIN ROCK-EAST
TFILLP 0.0000E+00 2.0000E+00 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 4968 3059 3059

FIGURE C-35. RAW VELOCITY RECORD FILTERED, TFILLP, TO 2500 HZ AND DECIMATED TO 6000 SAMPLES/SEC




```
CURVE 1     PAGE 18
43FEVV002A!00R250    0 LI                250--2-UV -E        WES
6.0002E+03                        --9.0929E-02        5.3736E--02
0.0000E+00      5.9981E-01        --9.0929E-02        5.3736E-02
--UV 13-1 MIN ROCK-EAST
 TFILLP    0.0000E+00 2.0000E+00 2.5000E+03 0.0000E+00 6.0000E+00
           0.0000E+00                    0       3059       3059
 PINT      0.0000E+00
                                         0       3059       3059
```

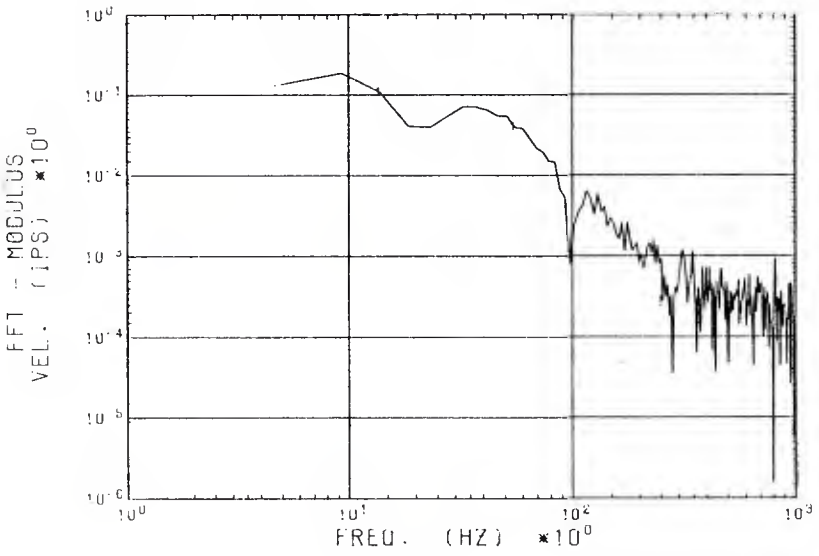
FIGURE C-36. FILTERED VELOCITY RECORD INTEGRATED, PINT, TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 11
43FEVV002A100R250 V L 250-2-UV -E WES
6.0002E+03 -8.5990E+00 3.2330E+00
3.5165E-02 2.4999E-01 -8.5990E+00 3.2330E+00
-UV 13-1 MIN ROCK-EAST
TFILLP 0.0000E+00 2.0000E+00 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 0 4968 3059

CURVE 2 PAGE 11
43FEVV002A100R250 D L.I 250-2-UV -E WES
6.0002E+03 -9.1347E-02 2.5572E-02
3.5165E-02 2.4999E-01 -9.1347E-02 2.5572E-02
-UV 13-1 MIN ROCK-EAST
TFILLP 0.0000E+00 2.0000E+00 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 0 4968 3059
PINT 0.0000E+00
0 4968 3059

FIGURE C-37. FILTERED VELOCITY RECORD WITH PRESHOCK ARRIVAL NOISE REMOVED AND INTEGRATED TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 12
43FEVV002A!00R250 FV LAF 250--2-UV --E WES
2.1599E--01 1.5697E--06 1.8544E--01
4.6298E+00 9.9541E+02 1.5697E--06 1.8544E--01
-UV 13--1 MIN ROCK-EAST

TFILLP	0.0000E+00	2.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4968	3059
FOUR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4968	3059
CPOL	0.0000E+00				
			0	4968	3059

FIGURE C-38. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP VELOCITY RECORD WITH REAR 10% OF RECORD COSINE TAPERED

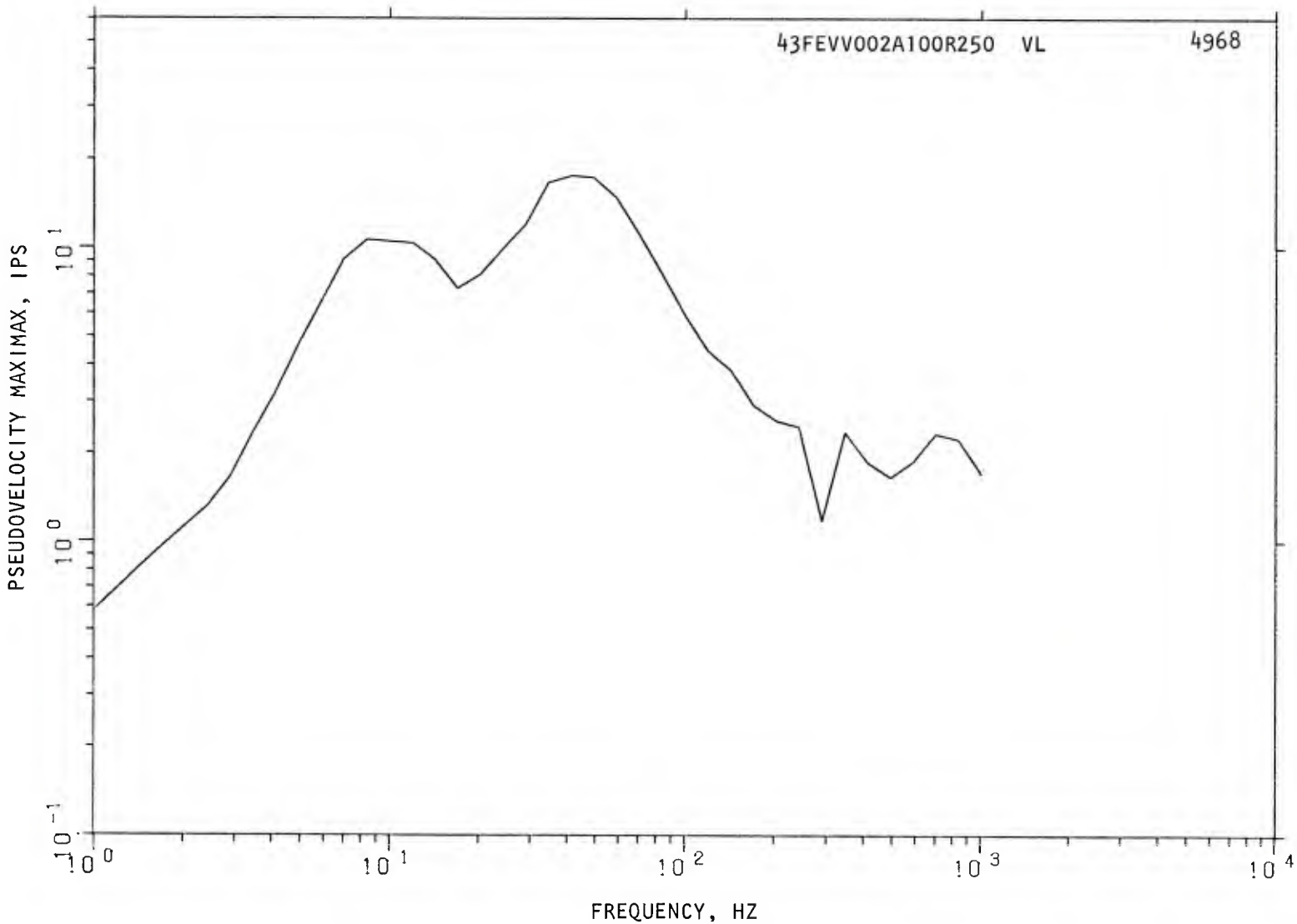
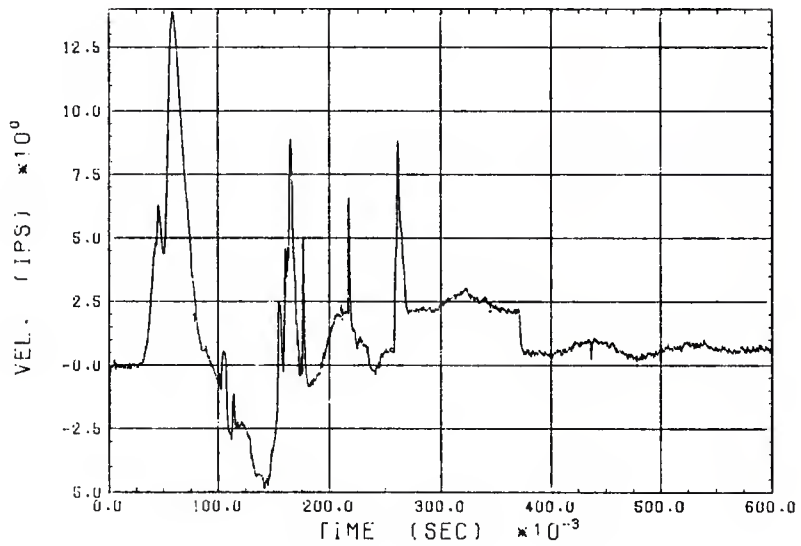


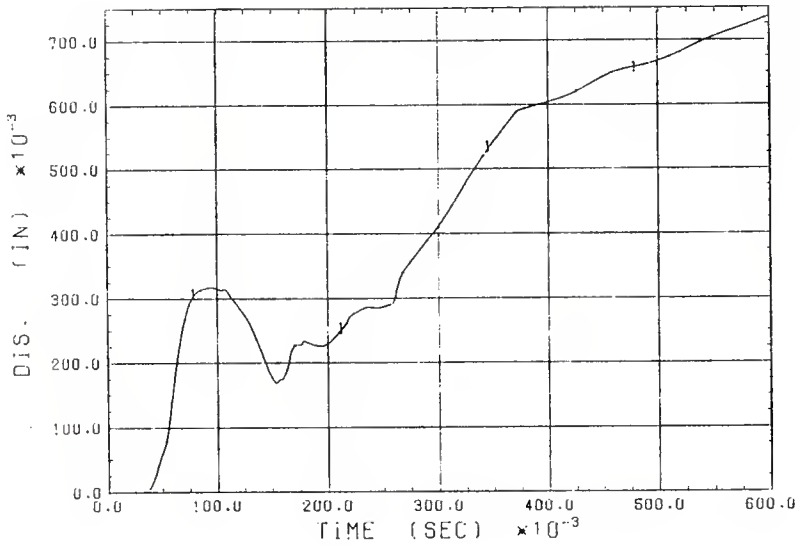
FIGURE C-39. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP VELOCITY RECORD WITH NO DAMPING AND NO RESIDUAL

FILE 3060



CURVE 1 PAGE 19
43FEVN002A!DOR250 V L 250-2-UH -E WES
6.0002E+03 -4.8421E+00 1.3897E+01
0.0000E+00 5.9981E-01 -4.8421E+00 1.3897E+01
-UH 13-2 MIN ROCK-EAST
TFILLP 0.0000E+00 2.0000E+00 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 4969 3060 3060

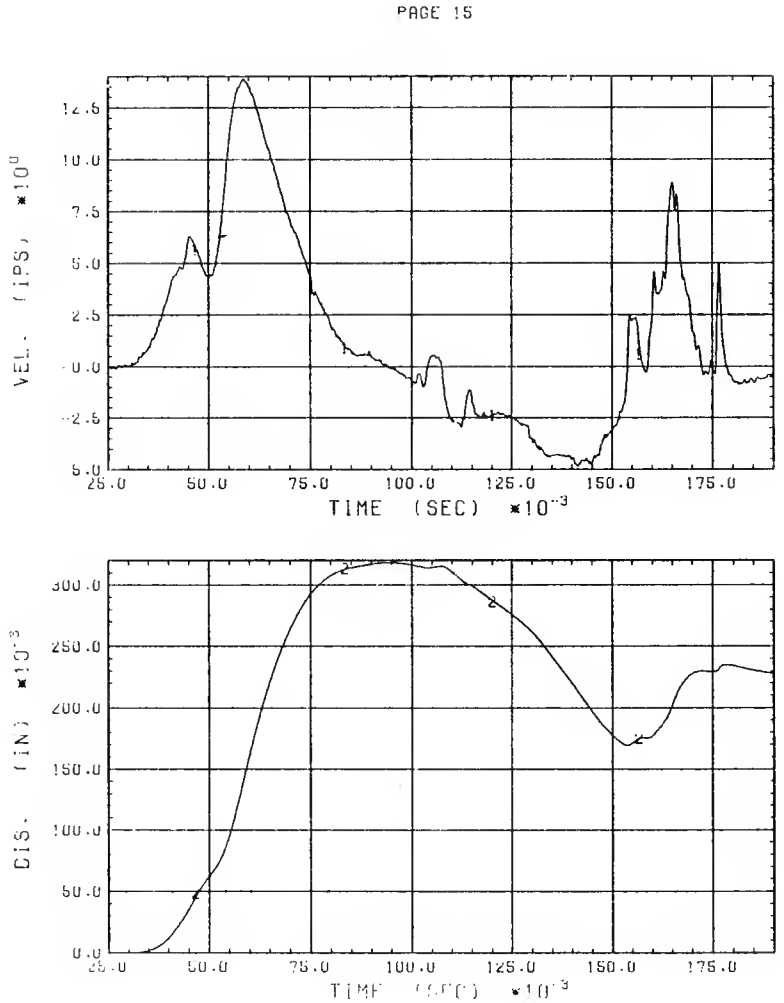
FIGURE C-40. RAW VELOCITY RECORD FILTERED, TFILLP, TO 2500 HZ AND DECIMATED TO 6000 SAMPLES/SEC



CURVE 1 PAGE 20
43FEVN002A!00R250 D L.i 250-2-UH -E WES
6.0002E+03 -1.0575E-03 7.3671E-01
0.0000E+00 5.9981E-01 -1.0575E-03 7.3671E-01
-UH 13-2 MIN ROCK-EAST

TFILLP	0.0000E+00	2.0000E+00	2.5000E-03	0.0000E+00	6.0000E+00
	0.0000E+00		0	3060	3060
PINT	0.0000E+00				
			0	3060	3060

FIGURE C-41. FILTERED VELOCITY RECORD INTEGRATED, PINT, TO OBTAIN DISPLACEMENT



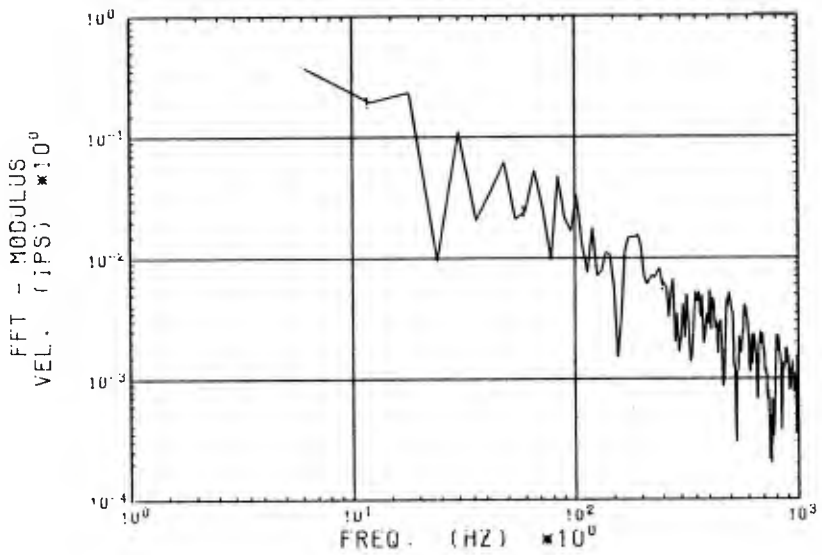
CURVE 1 PAGE 15
43FEVN002A100R250 V L 250-2-UH -E WES
6.0002E+03 -4.8421E+00 1.3897E+01
2.5166E-02 1.8999E-01 -4.8421E+00 1.3897E+01
-UH 13-2 MIN ROCK-EAST

TFILLP	0.0000E+00	2.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00	
	0.0000E+00		0	4969	3060	

CURVE 2 PAGE 15
43FEVN002A100R250 D LI 250-2-UH -E WES
6.0002E+03 -1.3309E-04 3.1812E-01
2.5166E-02 1.8999E-01 -1.3309E-04 3.1812E-01
-UH 13-2 MIN ROCK-EAST

TFILLP	0.0000E+00	2.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00	
	0.0000E+00		0	4969	3060	
PINT	0.0000E+00					
			0	4969	3060	

FIGURE C-42. FILTERED VELOCITY RECORD WITH PRESHOCK ARRIVAL NOISE REMOVED AND INTEGRATED TO OBTAIN DISPLACEMENT



CURVE 1 PAGE 16
43FEVN002A100R250 FV LAF 250-2-UH --E WES
1.6666E-01 1.9956E-04 3.8297E-01
6.0002E+00 9.9604E+02 1.9956E-04 3.8297E-01
--UH 13-2 MIN ROCK-EAST

TFILLP	0.0000E+00	2.0000E+00	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4969	3060
FOUR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4969	3060
CPOL.	0.0000E+00				
			0	4969	3060

FIGURE C-43. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP VELOCITY RECORD WITH REAR 10% OF RECORD COSINE TAPERED

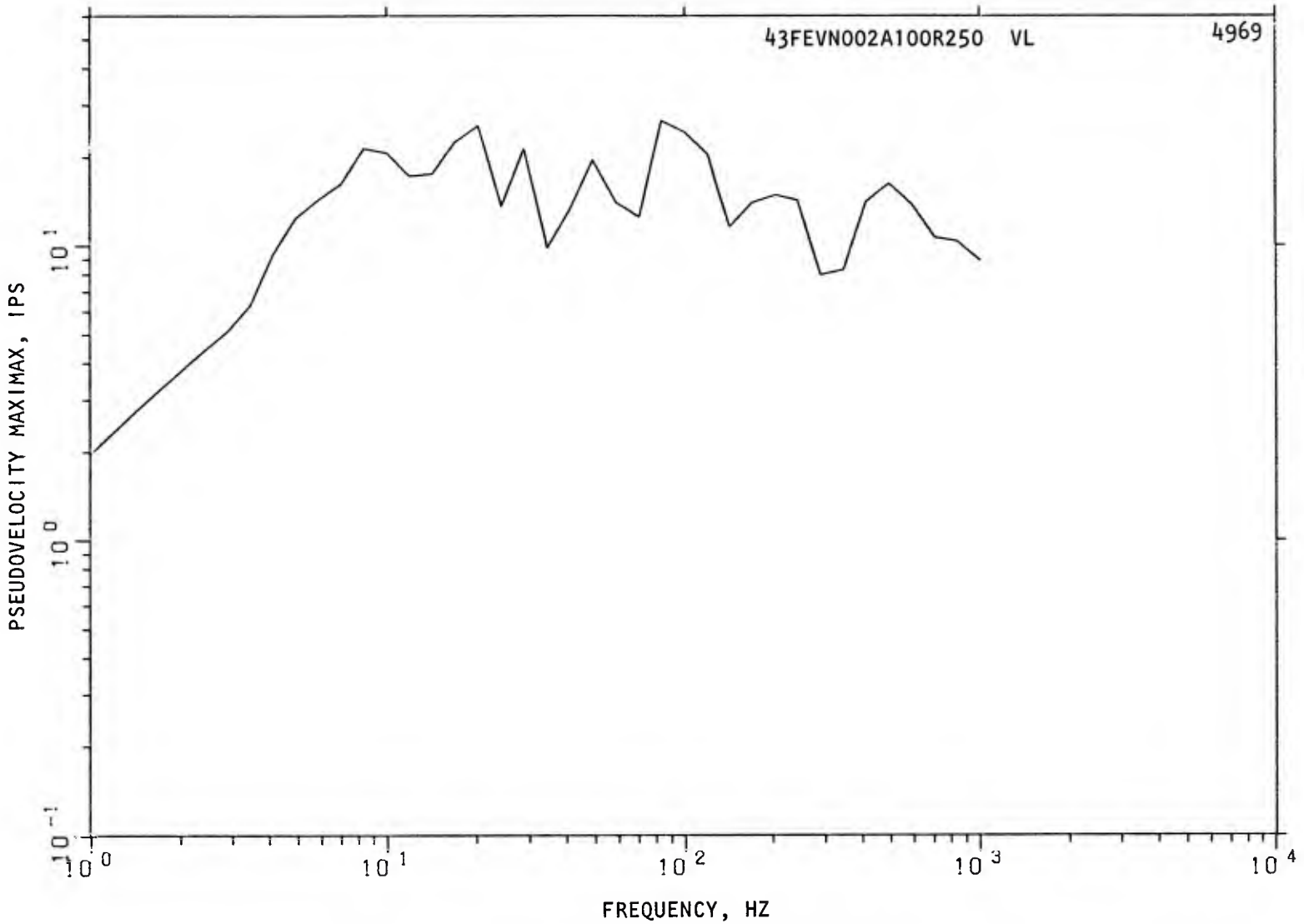
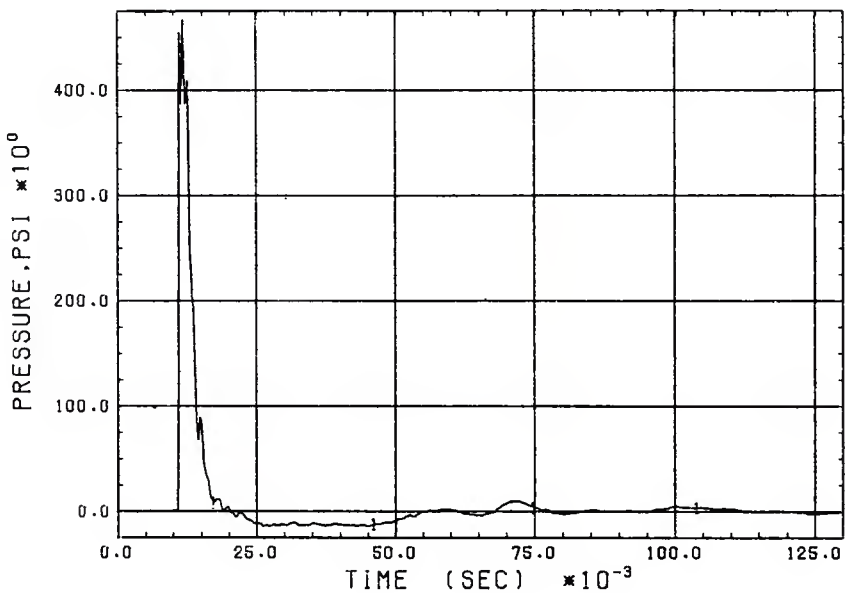


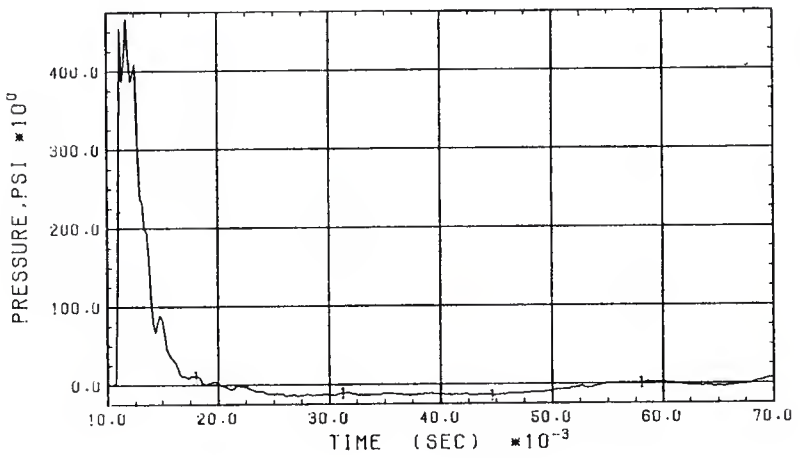
FIGURE C-44. SHOCK SPECTRA, SHOXVE, OF CLEANED-UP VELOCITY RECORD WITH NO DAMPING AND NO RESIDUAL

FILE 4476

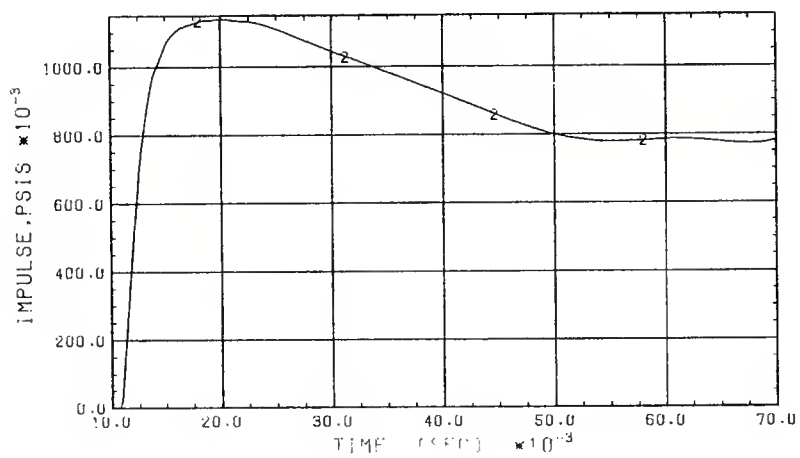



```
CURVE 1    PAGE 1
43BEPS000A150R120   P L                                          BRL
5.0000E+03                          -1.4730E+01      4.6669E+02
-1.0000E-05     1.3019E-01          -1.4730E+01      4.6669E+02
 2-14.120.0
 TFILLP    0.0000E+00  2.0000E+01  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                    4970        4476        4476
```

FIGURE C-45. RAW AIR-BLAST RECORD FILTERED, TFILLP, TO 2500 HZ AND DECIMATED TO 5000 SAMPLES/SECOND

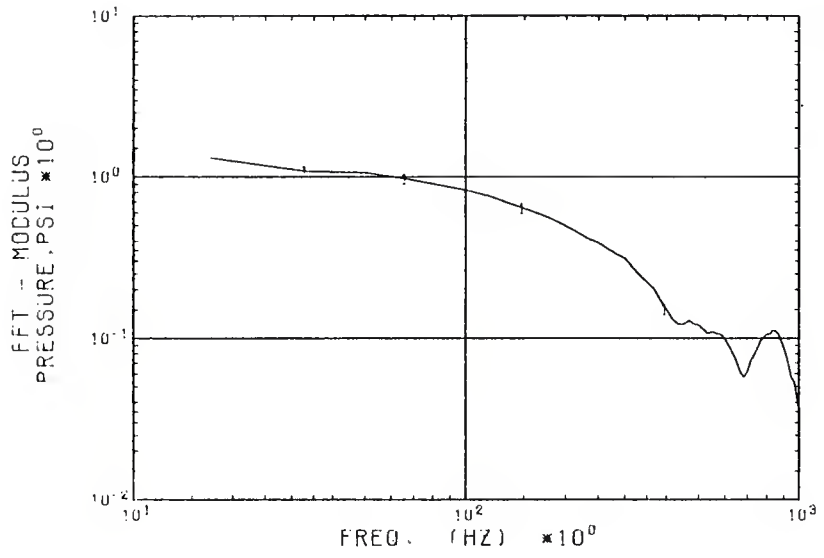


CURVE 1 PAGE 17
43BEPS000A150R120 P L BRL
5.0000E+03 -1.4730E+01 4.6669E+02
1.0190E-02 6.9990E-02 -1.4730E+01 4.6669E+02
2-14.120.0
TFILLP 0.0000E+00 2.0000E+01 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 0 4970 4476



CURVE 2 PAGE 17
43BEPS000A150R120 I LI BRL
5.0000E+03 2.5687E-04 1.1395E+00
1.0190E-02 6.9990E-02 2.5687E-04 1.1395E+00
2-14.120.0
TFILLP 0.0000E+00 2.0000E+01 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 0 4970 4476
PINT 0.0000E+00
0 4970 4476

FIGURE C-46. FILTERED AIR-BLAST RECORD WITH PRESHOCK ARRIVAL NOISE REMOVED AND INTEGRATED TO OBTAIN IMPULSE

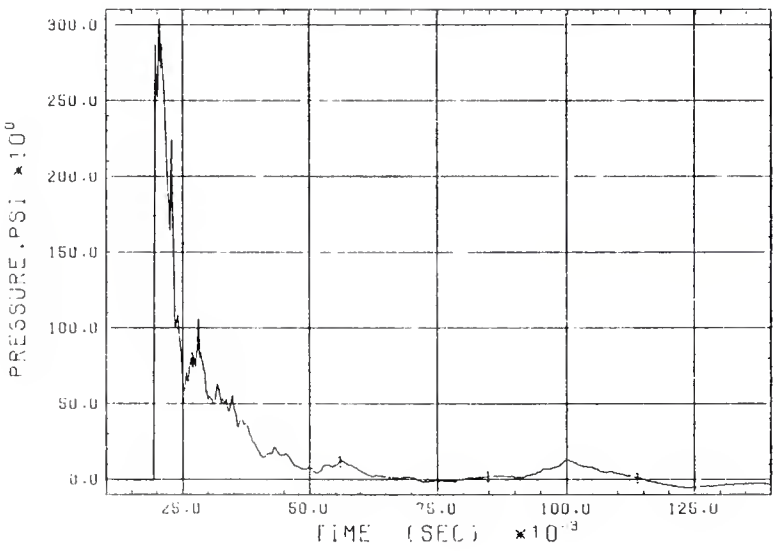


CURVE 1 PAGE 18
43BEPS000A150R120 FP LAF BRL
6.0000E-02 3.5899E-02 1.3220E+00
1.6667E+01 1.0000E+03 3.5899E-02 1.3220E+00
2-14.120.0

TFILLP	0.0000E+00	2.0000E+01	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4970	4476
FOUR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4970	4476
CPOL	0.0000E+00				
			0	4970	4476

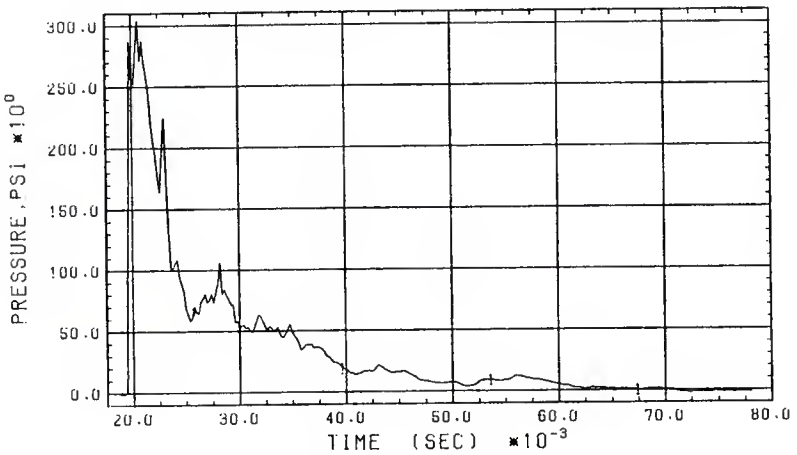
FIGURE C-47. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP AIR-BLAST RECORD WITH REAR 10% OF RECORD COSINE TAPERED

FILE 4477



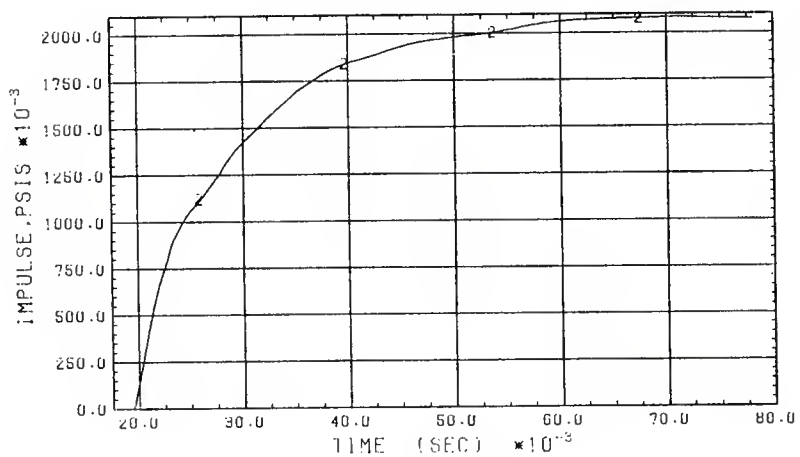
CURVE 1 PAGE 2
43BEPS000A!50R170 P L BRL
5.0000E+03 -5.6340E+00 3.0430E+02
9.9990E-03 1.4020E-01 -5.6340E+00 3.0430E+02
2-15.170.0
TFILLP 0.0000E+00 2.0000E+01 2.5000E-03 0.0000E+00 6.0000E+00
0.0000E+00 4971 4477 4477

FIGURE C-48. RAW AIR-BLAST RECORD FILTERED, TFILLP, TO 2500 HZ AND DECIMATED TO 5000 SAMPLES/SEC



CURVE 1 PAGE 19
43BEPS000A150R170 P L BRL
5.0000E+03 -2.1389E+00 3.0430E+02
1.8199E-02 7.7999E-02 -2.1389E+00 3.0430E+02
2-15.170.0

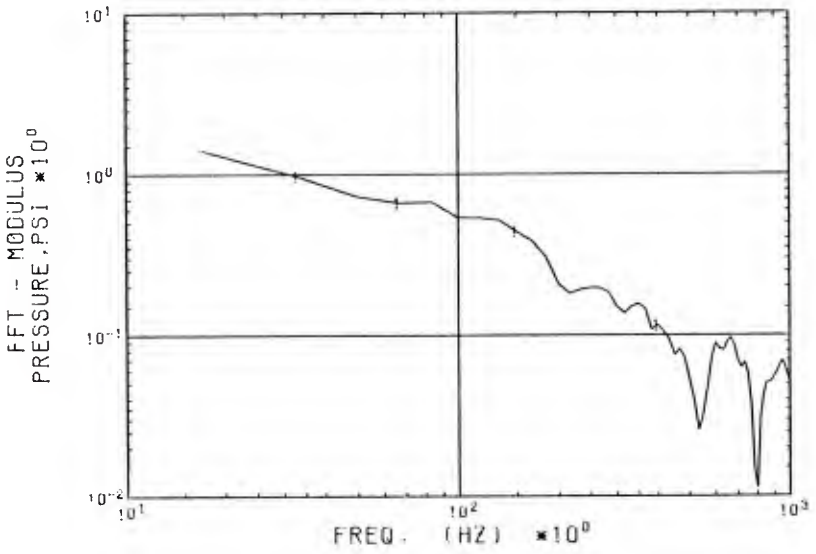
TFILLP	0.0000E+00	2.0000E+01	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4971	4477



CURVE 2 PAGE 19
43BEPS000A150R170 I LI BRL
5.0000E+03 -5.7008E-04 2.0827E+00
1.8199E-02 7.7999E-02 -5.7008E-04 2.0827E+00
2-15.170.0

TFILLP	0.0000E+00	2.0000E+01	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4971	4477
PINT	0.0000E+00				
			0	4971	4477

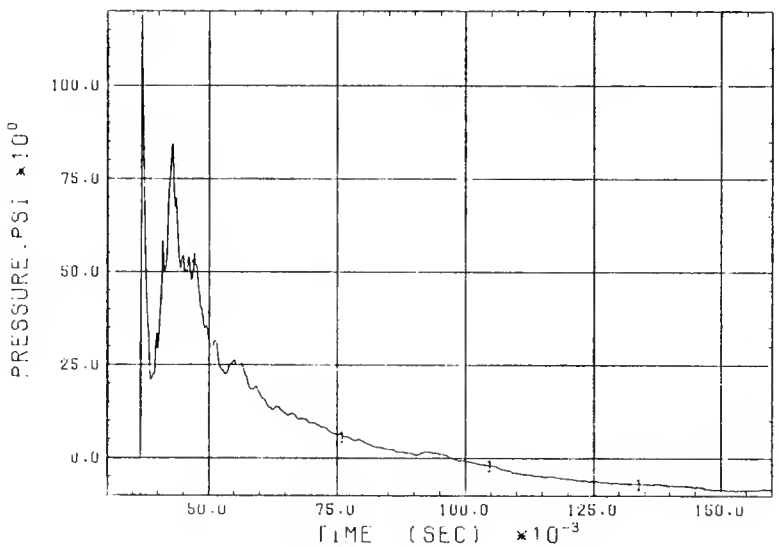
FIGURE C-49. FILTERED AIR-BLAST RECORD WITH PRESHOCK ARRIVAL NOISE REMOVED AND INTEGRATED TO OBTAIN IMPULSE



CURVE 1 PAGE 20
43BEPS000A1SOR17O FP LAF BRL
6.0000E-02 1.1299E-02 1.4276E+00
1.6667E+01 1.0000E+03 1.1299E-02 1.4276E+00
2-15.170.0
TFILLP 0.0000E+00 2.0000E+01 2.5000E+03 0.0000E+00 0.0000E+00
0.0000E+00 0 4971 4477
F0UR 0.0000E+00 4.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00
0 4971 4477
CP0L 0.0000E+00
0 4971 4477

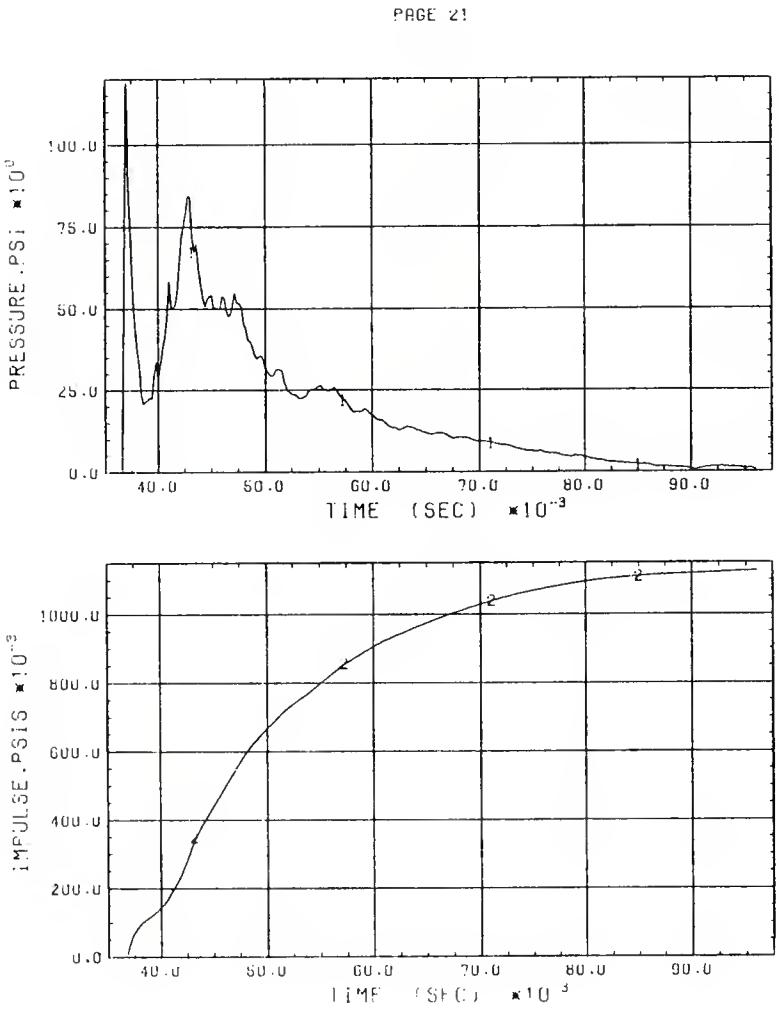
FIGURE C-50. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP AIR-BLAST RECORD WITH REAR 10% OF RECORD COSINE TAPERED

FILE 4478



CURVE 1 PAGE 3
43BEPS000A150R250 P L BRL
5.0000E+03 -8.8400E+00 1.1890E+02
3.0000E-02 1.6020E-01 -8.8400E+00 1.1890E+02
2-16.250.0
TFILLP 0.0000E+00 2.0000E+01 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 4972 4478 4478

FIGURE C-51. RAW AIR-BLAST RECORD FILTERED, TFILLP, TO 2500 HZ AND DECIMATED TO 5000 SAMPLES/SEC

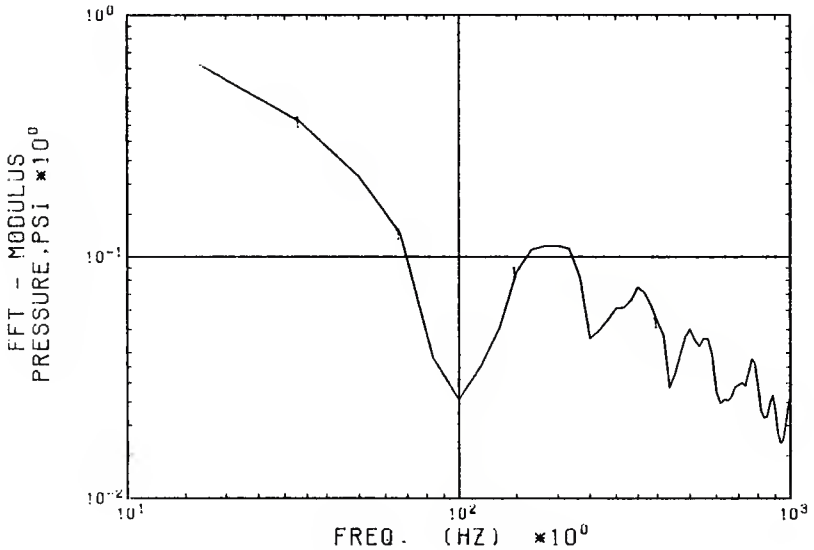



```
CURVE 1     PAGE 21
43BEPS000A150R250    P L                                                BRL
5.0000E+03                          -2.3303E-01       1.1890E+02
3.6200E-02       9.6000E-02         -2.3303E-01       1.1890E+02
 2-16.250.0
 TFILLP    0.0000E+00  2.0000E+01  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                        0        4972        4478
```

```
CURVE 2     PAGE 21
43BEPS000A150R250    I L I                                              BRL
5.0000E+03                          -7.3557E-05       1.1263E+00
3.6200E-02       9.6000E-02         -7.3557E-05       1.1263E+00
 2-16.250.0
 TFILLP    0.0000E+00  2.0000E+01  2.5000E+03  0.0000E+00  6.0000E+00
           0.0000E+00                        0        4972        4478
 PINT      0.0000E+00
                                             0        4972        4478
```

FIGURE C-52. FILTERED AIR-BLAST RECORD WITH PRESHOCK ARRIVAL NOISE REMOVED AND INTEGRATED TO OBTAIN IMPULSE

PAGE 22



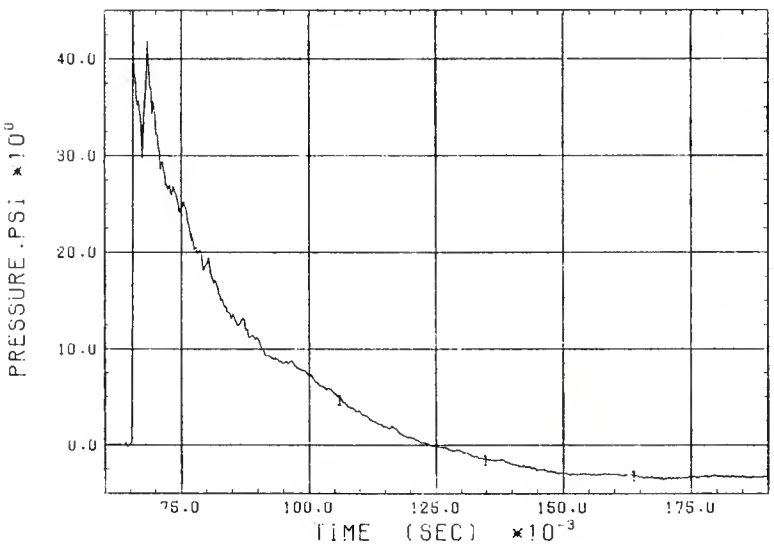
CURVE 1 PAGE 22
43BEPS000A150R250 FP LAF BRL
6.0000E-02 1.6947E-02 6.2163E-01
1.6667E+01 1.0000E+03 1.6947E-02 6.2163E-01
2-16.250.0

TFILLP	0.0000E+00	2.0000E+01	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4972	4478
F0UR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4972	4478
CP0L	0.0000E+00				
			0	4972	4478

FIGURE C-53. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP AIR-BLAST RECORD WITH REAR 10% OF RECORD COSINE TAPERED

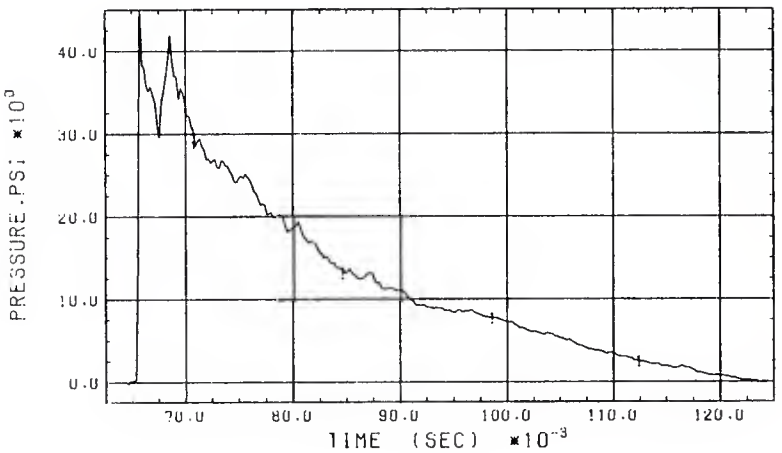
FILE 4479

PAGE 4

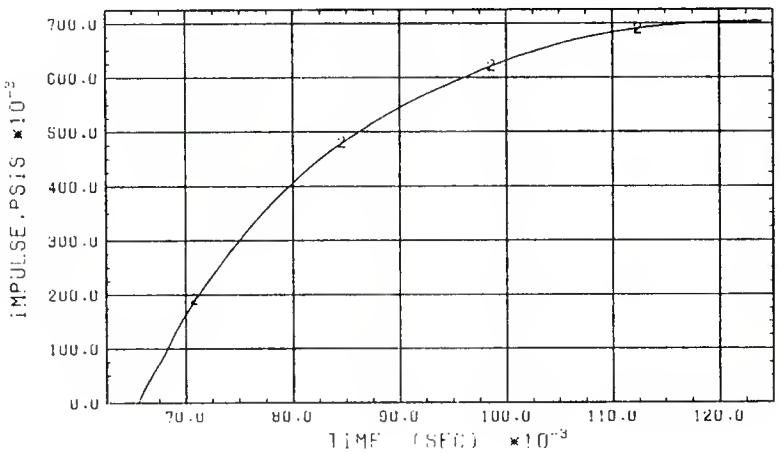


CURVE 1 PAGE 4
43BEPS000A150R320 P L BRL
5.0000E+03 -3.5752E+00 4.5089E+01
5.9990E-02 1.9019E-01 -3.5752E+00 4.5089E+01
2-18.320.0
TFILLP 0.0000E+00 2.0000E+01 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 4973 4479 4479

FIGURE C-54. RAW AIR-BLAST RECORD FILTERED, TFILLP, TO 2500 HZ AND DECIMATED TO 5000 SAMPLES/SEC

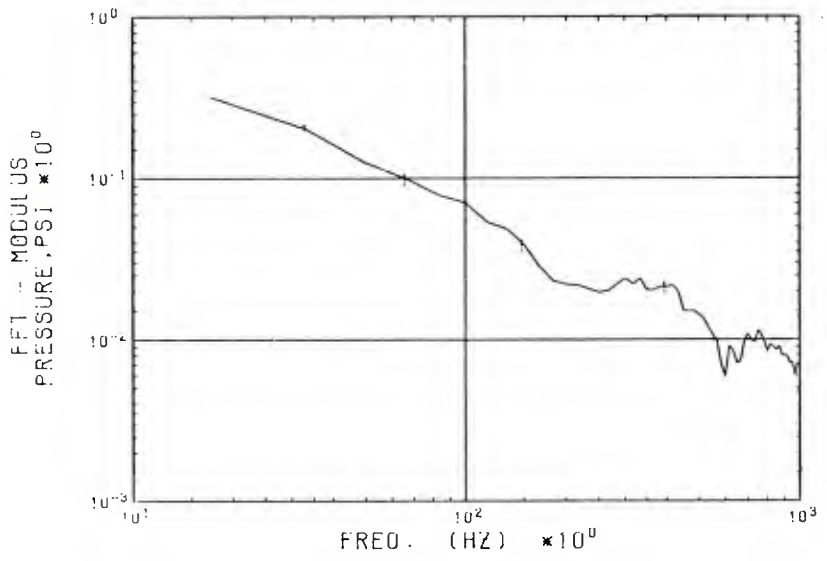


CURVE 1 PAGE 23
43BEPS000A150R320 P L BRL
5.0000E+03 -1.8193E-01 4.5089E+01
6.4190E-02 1.2399E-01 -1.8193E-01 4.5089E+01
2-18.320.0
TFILLP 0.0000E+00 2.0000E+01 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 0 4973 4479



CURVE 2 PAGE 23
43BEPS000A150R320 I LI BRL
5.0000E+03 2.1426E-05 7.0413E-01
6.4190E-02 1.2399E-01 2.1426E-05 7.0413E-01
2-18.320.0
TFILLP 0.0000E+00 2.0000E+01 2.5000E+03 0.0000E+00 6.0000E+00
0.0000E+00 0 4973 4479
PINT 0.0000E+00
0 4973 4479

FIGURE C-55. FILTERED AIR-BLAST RECORD WITH PRESHOCK ARRIVAL NOISE REMOVED AND INTEGRATED TO OBTAIN IMPULSE



CURVE 1 PAGE 24

43BEPS000A!SOR320 FP LAF BRL

6.0000E-02			5.9552E-03	3.2536E-01	
1.6667E+01	1.0000E+03		5.9552E-03	3.2536E-01	
2--18.320.0					
TFILLP	0.0000E+00	2.0000E+01	2.5000E+03	0.0000E+00	6.0000E+00
	0.0000E+00		0	4973	4479
FOUR	0.0000E+00	4.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
			0	4973	4479
CPOL	0.0000E+00				
			0	4973	4479

FIGURE C-56. FOURIER TRANSFORM, FOUR AND CPOL, OF CLEANED-UP AIR-BLAST RECORD WITH REAR 10% OF RECORD COSINE TAPERED

APPENDIX D

General Labor and Computer Estimation Guidelines

APPENDIX D

GENERAL LABOR AND COMPUTER ESTIMATION GUIDELINES

It has been established that potential Archive users should have access to guidelines that will allow them to estimate the computer hours and labor hours required for data processing. Therefore, this appendix presents general guidelines resulting from an analysis based primarily on the processing described in Section 2.

The guidelines are oriented to typical processing areas including:

a. Filtering and decimation
b. Detrending of acceleration, velocity, and air-blast measurements
c. Calculation of shock spectra
d. Calculation of Fourier transforms
e. Calculation of both Fourier transforms and shock spectra

All computer time estimates are based on the work performed with a UNIVAC 1108, Executive II.

D.1 REQUIRED INFORMATION

In order to perform an accurate estimate, certain information must be compiled. The sources of this information are to be derived from:

a. The requirements of the user
b. Reference 4

The following is a description of the information needed from each source.

D.1.1 INVESTIGATOR PROVIDED INFORMATION

The investigator must decide which of the available measurements are to be processed. The following information must then be compiled for each measurement:

a. Measurement type; i.e., air blast, velocity, acceleration, etc.

b. Frequency limits, usually consisting of some lower limit approaching zero and an upper limit representing the highest frequency of interest (Hz), f_m

c. Time limits, consisting of the length of the time segment of interest (sec), T_m

All the measurements should then be combined into groups having the same measurement type, highest frequency of interest, and length of time segment of interest.

The information that should be compiled for each group consists of:

a. The number of measurements.

b. Measurement type.

c. Highest frequency of interest (Hz), f_m.

d. Length of the time segment of interest (sec), T_m.

e. A list of the absolute file numbers that correspond to the measurements. This can be obtained by referring to Reference 4 or Reference 6.

D.1.2 REFERENCE PROVIDED INFORMATION

Making use of Reference 4, combined with the list of absolute file numbers, the user must then compile information for each measurement of a group consisting of the following:

a. DELTA X, the sampling increment (sec), Δx

b. FOOTAGE, the location of the measurement on tape, F

c. The previous entry's FOOTAGE, corresponding to the location of the previous file on the tape, F'

The combination of this information, along with that discussed in Section D.1.1, is needed to define the values of the parameters used in the guideline algorithms.

An example of an information tabulation for the data discussed in Section 2.1 is presented in Table D-1.

D.2 PARAMETER VALUE CALCULATIONS

In order to make use of the guideline algorithms presented in Section D.3, the following parameter values must be calculated for each measurement of a group:

a. Decimation ratio, d
b. Number of samples, n_s
c. Segment ratio, s

All groups are then further subdivided into classes having the same decimation ratio, number of samples, and segment ratio values. The following is a discussion of the method used to determine the value of these parameters. Refer to Table D-2 for an example.

TABLE D-1. SUMMARY OF INVESTIGATOR AND REFERENCE INFORMATION FOR RDA REQUEST

Group	Number of Measurements	Measurement Type	Highest Frequency of Interest (Hz), f_m	Length of Time Segment of Interest (sec), T_m	Absolute File Number	Sampling Increment (sec), Δx	Location of Measurement, F	Location of Previous Entry, F'
1	2	Acc.	800	0.080	2681 2649	0.11111×10^{-3} 0.11111×10^{-3}	923.1 215.8	901.5 194.2
2	1	Acc.	800	0.150	2898	0.11111×10^{-3}	1572.8	1551.2
3	2	Acc.	800	0.200	2666 3465	0.11111×10^{-3} 0.41670×10^{-4}	591.4 515.9	568.4 448.7
4	3	Acc.	800	0.100	3380 3384 3362	0.41670×10^{-4} 0.41670×10^{-4} 0.41670×10^{-4}	1445.5 1714.2 598.7	1378.3 1647.0 531.6
5	1	Acc.	800	0.250	3453	0.41670×10^{-4}	2225.7	2152.3
6	1	Acc.	800	0.300	3457	0.83330×10^{-4}	176.2	141.9

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TABLE D-2. SUMMARY OF PARAMETER VALUE CALCULATIONS FOR RDA REQUEST

Group	Number of Classes	Class	Number of Measurements, m_c	Decimation Ratio, d	Number of Samples, n_s	Segment Ratio, s	Absolute File Number
1	1	1A	2	0.5	29628	0.024	2681 2649
2	1	2A	1	0.5	29628	0.046	2898
3	2	3A	1	0.5	31668	0.057	2666
		3B	1	0.2	96067	0.050	3465
4	1	4A	3	0.2	96067	0.025	3380 3384 3362
5	1	5A	1	0.2	105101	0.057	3453
6	1	6A	1	0.5	48132	0.075	3457

D.2.1 DECIMATION RATIO

For each measurement, the decimation ratio is defined as roughly six times the sampling increment times the highest frequency of interest. This can be represented as:

$$d = 6(\Delta x)\ f_m$$

where

d = Decimation ratio
Δx = Sampling increment (sec)
f_m = Highest frequency of interest (Hz)

Refer to Figure D-1 for specific values of decimation rates.

D.2.2 NUMBER OF SAMPLES

For each measurement, the number of samples is equivalent to one thousand four hundred fifty-seven (1,457) times the difference between the location of the measurement on tape and the location of the previous master-file entry on tape minus one thousand eight hundred forty-three (1,843). This can be represented as:

$$n_s = 1457(F - F') - 1843$$

where

n_s = Number of samples
F = Location of the measurement on tape
F' = Location of the previous masterfile entry on tape

Refer to Figure D-2 for specific values of number of samples.

D.2.3 SEGMENT RATIO

For each measurement, the segment ratio is equivalent to the ratio of the length of the time segment of interest to one less than the number of

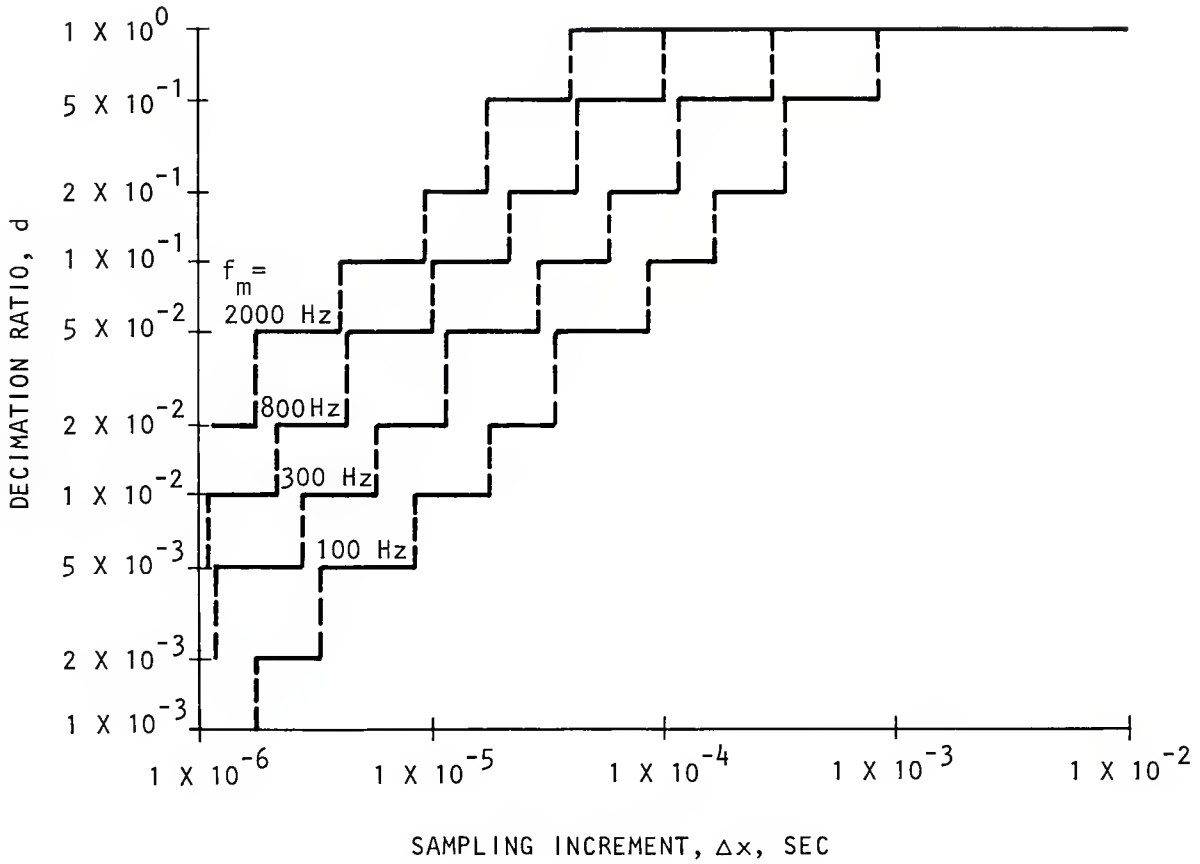

FIGURE D-1. DECIMATION RATIO (d) VERSUS SAMPLING INCREMENT (Δx) AND HIGHEST FREQUENCY OF INTEREST (f_m)

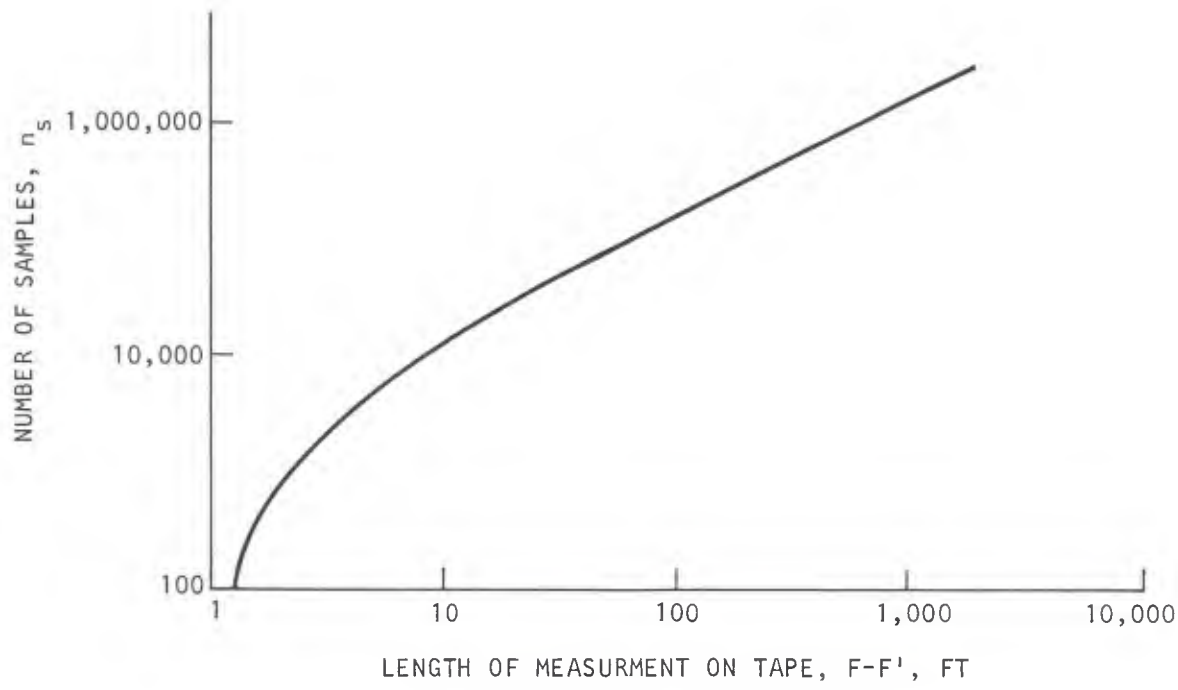

FIGURE D-2. NUMBER OF SAMPLES (n_s) VERSUS LENGTH OF MEASUREMENT ON TAPE (F-F')

samples times the sampling interval. This can be represented as:

$$s = \frac{T_m}{(n_s - 1)(\Delta x)}$$

where

s = Segment ratio
T_m = Length of the time segment of interest (sec)
n_s = Number of samples
Δx = Sampling increment (sec)

Refer to Figure D-3 for values of segment ratio.

D.3 ESTIMATE OF COMPUTER TIME AND LABOR

When the parameter values discussed in Section D.2 have been calculated and the measurements in each group have been further subdivided into classes containing measurements with the same parameter values, an estimate for performing a processing procedure on a class of measurements can be made, and, from that, an estimate for processing an entire group of measurements.

This is accomplished by selecting a procedure to be performed. The following is a description of the processing procedures for which guidelines have been developed and a discussion of the method for computing the corresponding computer and labor estimate.

D.3.1 FILTERING AND DECIMATION

This procedure consists of the following functions:

a. Retrieve measurement file.

b. Filter and decimate entire file with respect to specified frequency limits.

c. Plot filtered and decimated file.

d. Return entire filtered and decimated file to Archive.

e. Retrieve filtered and decimated file.

f. Plot filtered and decimated file over specified time limits.

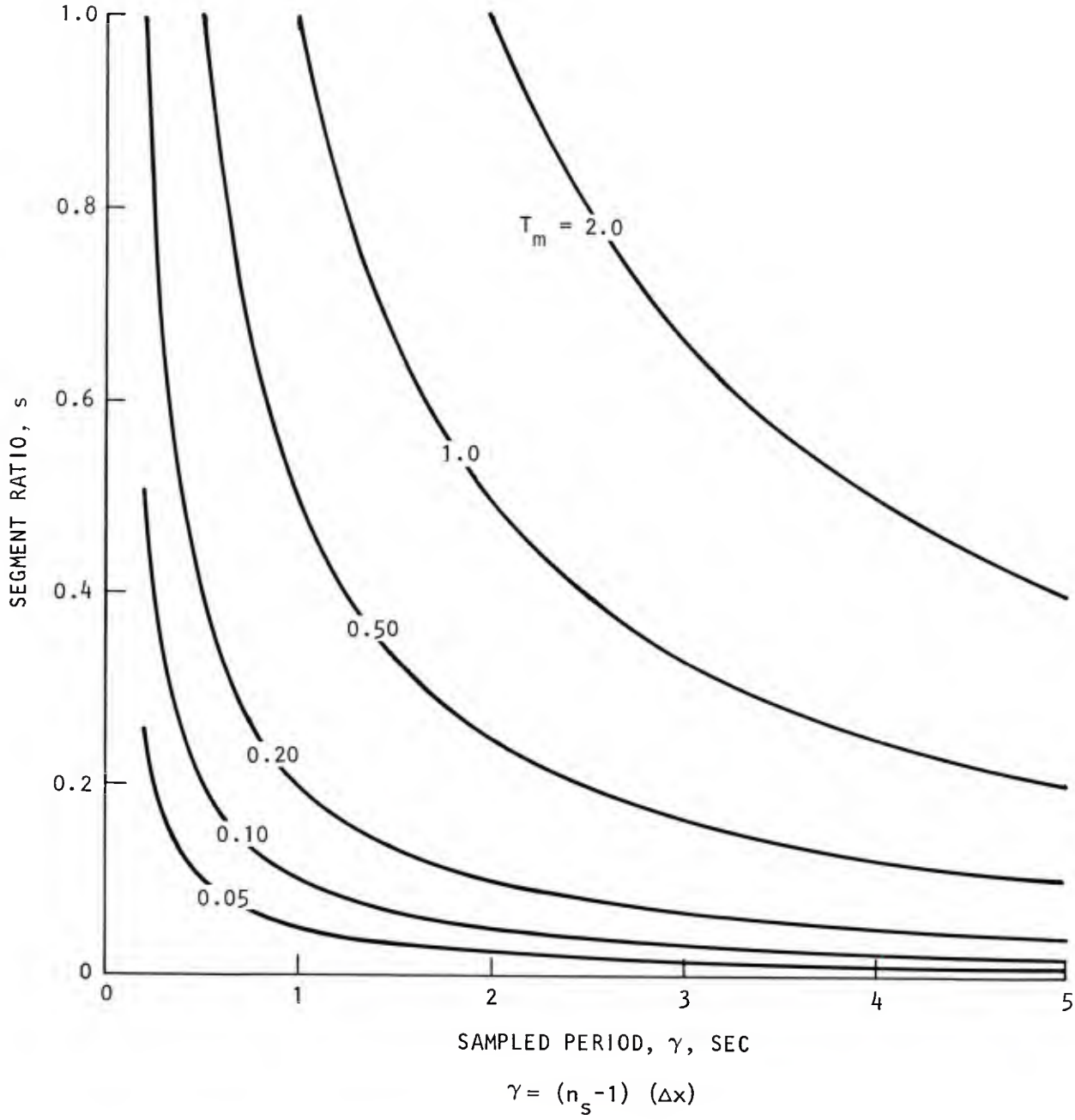

FIGURE D-3. SEGMENT RATIO (s) VERSUS NUMBER OF SAMPLES (n_s), SAMPLING INCREMENT (Δx), AND LENGTH OF TIME SEGMENT OF INTEREST (T_m)

The algorithm for determining the uncorrected* amount of computer time for performing this procedure on a measurement in a specific class can be expressed as:

$$t_m = 0.0168 + \frac{n_s}{1{,}000{,}000}\left[0.620 + d(0.776 + 0.527\ s)\right]$$

where

t_m = Uncorrected computer time per measurement in a class (hr)

n_s = Numbers of samples

d = Decimation ratio

s = Segment ratio

The next step is to calculate the uncorrected amount of computer time to process a class of measurements. This is equivalent to the product of number of measurements in a class and the uncorrected computer time per measurement in the respective class. This can be represented as:

$$t_c = m_c t_m$$

where

t_c = Uncorrected computer time per class (hr)

m_c = Number of measurements in the class

t_m = Uncorrected computer time per measurement (hr)

The uncorrected amount of computer time to process a group of files can be expressed as the sum of all the uncorrected computer times for each class of that group. This can be expressed as:

$$t_g = t_{c_1} + t_{c_2} + t_{c_3} \ldots\ldots$$

---

*Note: The uncorrected time will be adjusted by an overhead factor in a subsequent equation.

where

t_g = Uncorrected computer time to process a group of measurements (hr)

t_{c_1} = Uncorrected computer time for first class of measurements (hr)

t_{c_2} = Uncorrected computer time for second class of measurements (hr)

t_{c_3} = Uncorrected computer time for third class of measurements (hr)

Finally, the computer time estimate for filtering and decimating all the measurements is equivalent to 0.131 plus the sum of all the uncorrected computer times to process each group of measurements. This can be represented by:

$$t = 0.131 + t_{g_1} + t_{g_2} + t_{g_3} \ldots\ldots$$

where

t = Computer time to process all measurements (hr)

t_{g_1} = Uncorrected computer time to process first group of measurements (hr)

t_{g_2} = Uncorrected computer time to process second group of measurements (hr)

t_{g_3} = Uncorrected computer time to process third group of measurements

The amount of estimated labor-hours to perform this procedure is equivalent to fifteen (15) plus the product of three and one-half (3.5) and the total number of involved measurements. This can be expressed as:

$$h = 15 + 3.5\, n_m$$

where

h = labor-hours (hr)

n_m = Total number of measurements

An example of the use of this estimating guideline as applied to the data processing request described in Section 2.1 can be found in Table D-3.

D.3.2 DETREND

This procedure consists of the following functions:

a. Retrieve measurement file.

b. Filter and decimate entire file with respect to specified frequency limits.

c. Calculate integrations for motion measurements (single integration for velocities, double integration for accelerations).

d. Plot the filtered and decimated file and respective integrations.

e. Return entire filtered and decimated file to Archive.

f. Retrieve filtered and decimated file.

g. Detrend filtered and decimated file.

h. Calculate integrations (single integration for air blasts and velocities, double integrations for accelerations).

TABLE D-3. SUMMARY OF ESTIMATE OF COMPUTER TIME AND LABOR-HOURS FOR FILTERING AND DECIMATION FOR RDA REQUESTED DATA

Group	Uncorrected Computer Time per Group (hr), t_g	Number of Classes	Class	Number of Measurements, m_c	Uncorrect Computer Time per Measurement (hr), t_m	Uncorrected Computer Time per Class (hr), t_c
1	0.0938	1	1A	2	0.0469	0.0938
2	0.0470	1	2A	1	0.0470	0.0470
3	0.1410	2	3A	1	0.0492	0.0492
			3B	1	0.0918	0.0918
4	0.2745	1	4A	3	0.0915	0.2745
5	0.0989	1	5A	1	0.0989	0.0989
6	0.0663	1	6A	1	0.0663	0.0663
	Total Corrected Time = 0.853					
	Total Labor-Hours h = 50					

i. Plot resulting detrended file and integrations over specified limits.

j. Return detrended file to Archive.

The algorithms for estimating the amount of computer time for performing this procedure are:

(air blasts only)

$$t_m = 0.0278 + \frac{n_s}{1{,}000{,}000} \left[0.620 + d(1.51 + 1.46\ s)\right]$$

(velocities only)

$$t_m = 0.0311 + \frac{n_s}{1{,}000{,}000} \left[0.620 + d(2.34 + 1.46\ s)\right]$$

(accelerations only)

$$t_m = 0.0353 + \frac{n_s}{1{,}000{,}000} \left[0.620 + d(2.87 + 1.98\ s)\right]$$

$$t_c = m_c t_m$$

$$t_g = t_{c_1} + t_{c_2} + t_{c_3} \ldots\ldots$$

$$t = 0.180 + t_{g_1} + t_{g_2} + t_{g_3} \ldots\ldots$$

The amount of estimated labor-hours to perform this procedure is equivalent to fifteen (15) plus the product of three and one-half (3.5) and the total number of involved measurements. This can be expressed as:

$$h = 15 + 3.5\ n_m$$

where

h = Labor-hours (hr)

n_m = Total number of measurements

An example of the use of the estimating guideline for the detrend procedure as applied to the data processing request described in Section 2.1 can be found in Table D-4.

D.3.3 SHOCK SPECTRA

This procedure consists of the following functions:

a. Retrieve detrended measurement file.
b. Calculate shock spectra over specified frequency limits.
c. Plot shock spectra on standard tripartite size grids.

The algorithms for estimating the amount of computer time for performing this procedure are:

$$t_m = 0.00737 + 1.024 \frac{n_s sd}{1,000,000}$$

$$t_c = m_c t_m$$

$$t_g = t_{c_1} + t_{c_2} + t_{c_3} \ldots\ldots$$

$$t = 0.0308 + t_{g_1} + t_{g_2} + t_{g_3} \ldots\ldots$$

The estimated number of labor-hours to perform this procedure is equivalent to three (3) times the total number of measurements to be processed. This can be expressed as:

$$h = 3.0\, n_m$$

where

h = labor-hours (hr)

n_m = Total number of measurements

Refer to Table D-5 for example.

TABLE D-4. SUMMARY OF ESTIMATE OF COMPUTER TIME AND LABOR-HOURS FOR DETRENDING OF RDA REQUESTED DATA

Group	t_g, hr	Number of Classes	Class	m_c	t_m, hr	t_c, hr
1	0.1938	1	1A	2	0.0969	0.1938
2	0.0975	1	2A	1	0.0975	0.0975
3	0.2541	2	3A	1	0.1022	0.1022
			3B	1	0.1519	0.1519
4	0.4530	1	4A	3	0.1510	0.4530
5	0.1632	1	5A	1	0.1632	0.1632
6	0.1378	1	6A	1	0.1378	0.1378
	Total Correct Time, t = 1.479					
	h = 50 Labor-Hours					

TABLE D-5. SUMMARY OF ESTIMATE OF COMPUTER TIME AND LABOR-HOURS FOR SHOCK SPECTRA OF RDA REQUESTED DATA

Group	t_g, hr	Number of Classes	Class	m_c	t_m, hr	t_c, hr
1	0.01546	1	1A	2	0.00773	0.01546
2	0.00806	1	2A	1	0.00806	0.00806
3	0.01664	2	3A	1	0.00829	0.00829
			3B	1	0.00835	0.00835
4	0.02358	1	4A	3	0.00786	0.02358
5	0.00859	1	5A	1	0.00859	0.00859
6	0.00922	1	6A	1	0.00922	0.00922
	Total corrected time t = 0.112					
	h = 30 Labor-Hours					

D.3.4 FOURIER TRANSFORM

This procedure consists of the following functions:

a. Retrieve filtered and decimated or detrended measurement file.
b. Calculate Fourier transform real and imaginary components.
c. Convert to amplitude and phase over specified frequency limits.
d. Plot Fourier amplitude on log-log grid.

The algorithms for estimating the amount of computer time for performing this procedure are:

$$t_m = 0.00897 + \frac{n_s sd}{1{,}000{,}000} \left[14.0 + 0.156\ d - 2.06\ \log_{10}(s\ d\ n_s)\right]$$

$$t_c = m_c t_m$$

$$t_g = t_{c_1} + t_{c_2} + t_{c_3} \ldots\ldots$$

$$t = 0.0377 + t_{g_1} + t_{g_2} + t_{g_3} \ldots$$

The estimated number of labor-hours to perform this procedure is equivalent to three (3) times the total number of measurements to be processed. This can be expressed as:

$$h = 3.0\ n_m$$

where

h = Labor-hours (hr)

n_m = Total number of measurements

Refer to Table D-6 for example.

TABLE D-6. SUMMARY OF ESTIMATE OF COMPUTER TIME AND LABOR-HOURS FOR FOURIER TRANSFORM OF RDA REQUESTED DATA

Group	t_g, hr	Number of Classes	Class	m_c	t_m, hr	t_c, hr
1	0.0242	1	1A	2	0.0121	0.0242
2	0.0146	1	2A	1	0.0146	0.0146
3	0.0327	2	3A	1	0.0162	0.0162
			3B	1	0.0165	0.0165
4	0.0393	1	4A	3	0.0131	0.0393
5	0.0182	1	5A	1	0.0182	0.0182
6	0.0223	1	6A	1	0.0223	0.0223
	t = 0.189					
	h = 30 Labor-Hours					

D.3.5 FOURIER TRANSFORM AND SHOCK SPECTRA

This procedure consists of the following functions:

a. Retrieve detrended measurement file.

b. Calculate Fourier transform real and imaginary components of measurement file.

c. Convert Fourier transform to amplitude and phase over specified frequency limits.

d. Plot Fourier amplitude on log-log grid.

e. Calculate shock spectra of measurement file over specified frequency limits.

f. Plot shock spectra on standard tripartite size grid.

The algorithms for estimating the amount of computer time for performing this procedure are:

$$t_m = 0.0149 + \frac{n_s\, sd}{1{,}000{,}000} \left[14.9 + 0.196\, d - 2.06 \log_{10}(s\, d\, n_s)\right]$$

$$t_c = m_c t_m$$

$$t_g = t_{c_1} + t_{c_2} + t_{c_3} \ldots\ldots$$

$$t = 0.0377 + t_{g_1} + t_{g_2} + t_{g_3} \ldots\ldots$$

The estimated number of labor-hours to perform this procedure is equivalent to three (3) times the total number of measurements to be processed. This can be expressed as:

$$h = 3.0\, n_m$$

where

h = Labor-hours (hr)

n_m = Total number of measurements

Refer to Table D-7 for example.

TABLE D.7. SUMMARY OF ESTIMATE OF COMPUTER TIME AND LABOR-HOURS FOR FOURIER TRANSFORM AND SHOCK SPECTRA OF RDA REQUESTED DATA

Group	t_g, hr	Number of Classes	Class	m_c	t_m, hr	t_c, hr
1	0.0368	1	1A	2	0.0184	0.0368
2	0.0211	1	2A	1	0.0211	0.0211
3	0.0462	2	3A	1	0.0229	0.0229
			3B	1	0.0233	0.0233
4	0.0582	1	4A	3	0.0194	0.0582
5	0.0252	1	5A	1	0.0252	0.0252
6	0.0299	1	6A	1	0.0299	0.0299
	t = 0.255 h = 30 Labor-Hours					

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